# AMATEUR WORK

A MONTHLY MAGAZINE OF THE USEFUL ARTS AND SCIENCES

Vol. VI. No. 2. BOSTON, DECEMBER, 1906. One Dollar a Year.

## A 150-WATT DYNAMO.

IRA M. CUSHING.

This dynamo is capable of delivering 10 amperes at 15 volts pressure when driven at a speed of 2200 R. P. M. The field frame and base should be cast in one piece. The outline of the base is shown in the lower right hand part of the illustration, which gives a plain view of half the machine. The base should be cored out underneath as much as possible in order to reduce the weight.

The field poles are square with well rounded corners. They are 1¼ in. vertical dimension and 2¼ in. wide in the direction of the shaft. The bearing pedestals are of course, cast separate from the bed plate and can be made of any suitable metal. Cast iron of same grade as field frame is probably the cheapest. They should be carefully set up in the lathe with the point where the center of the shaft will be as a center, and feet turned off to a radius of 3 5-32 in. This I would suggest as the first operation towards building the dynamos. Do *not* bore the bearing at this time. Note that the two bearing pedestals are different. The one at the commutator end has the bearing lengthened on the inside to support the brush yoke.

The field frame should now be centered on the lathe, clamped to the carriage and the fields bored for the armature. The bore is 2 9-16 in. or 2.5625 in., and extreme care should be exercised not to exceed it, as upon this turns as upon no other single operation, the successful working of the completed machine. I would even suggest that skilled workmen may slightly reduce the diameter of the field bore.

After boring the fields, and before taking the machine from the lathe, the place for the bearing pedestal at the side of the dynamo frame nearest the lathe head may be bored. The depth of the cut will depend upon the success attained in turning off the pedestals. If these were accurately turned the cut in the base should have a chord of 2 in. The field frame should now be turned end for end and, carefully centering it again with the aid of a mandrel, the location for the other pedestal can be turned out.

The pedestals should now be clamped in position and the holes for the machine screws that fasten them in place can be drilled and tapped. The field frame with pedestals in place should be centered on the lathe again, and the pedestals bored out to receive the brass bushings for the bearings. The boring should be ⅝ in. diameter. For bushings use a brass tube, with wall thick enough to give a chance to drill out for a running fit for the shaft, which is .375 in. diamter. The bushings should be driven into place and bored out before again removing the field frame form the lathe.

A simple way to prevent trouble from the bushings coming out again or turning would be to cut with a cold chisel a slight niche in the edge of the hole in the pedestals, both on the armature side and outside, and then with a prick punch upset the brass close to the niche. This will force the brass into the niche and hold the lining in place.

The pedestal at the commutator end can now be set in the lathe and the place for the brush yoke turned off. This should be .875 or ⅞ in. diameter and ¼ in. long. The pedestals should then be drilled for the oiling device. A plain hole can be drilled or can be drilled and tapped for oil or grease cup. If an oil cup is used a wick feed would be advisable. The grease cup would, however, probably give the best lubrication.

The field frame with its bearings can be set aside and the armature core and shaft started. The shaft consists of a piece of steel at least 11½ in. long. This allows for a pulley at one end. Two inches should be added to this if the builder wishes a pulley at each end. It is not advisable, however, to make the shaft any longer than necessary, as it is a difficult part to turn. The steel, to start with, should be at least 9-16 in. in diameter. Beginning at the commutator end the shaft is .375 or ⅜ in. in diameter for a length of 4¼ in. The diameter is then increased to .5626 or 9-16 in. for 3¼ in. and then reduced to .375 in. again for the length.

A No. 14 thread should be cut for about 5-16 in. on the commutator end of the enlarged part of the shaft and to fit this should be made a brass or steel nut ¼ in. thick. A steel washer 1¼ in. in diameter and ¼ in. thick should be fastened rigidly to the enlarged portion with its outer face ¼ in. from the shoulder of the shaft at pulley end. The easiest way would be to fit a brass pin through the washer into the shaft.

Between the nut and washer should be fitted enough discs to fill tightly the space of 2½ inches. These discs are 2½ in. in diameter, with a 9-16 in. shaft hole, and have twelve ⅜ in. holes, with their centers on a circle 2⅛ in. in diameter, punched around the edge. Both in making and assembling care should be taken to get the holes lined true. This can be done by putting a ⅜ in. rod through them and keeping the rod parallel to the shaft all the time. Clamps can be used to make the bundle of discs as compact at possible and the final tightening of the holding nut should be done with as much strength as can be used on a 6 in. wrench.

If the builder has a milling machine at hand he could assemble the blank discs on the shaft and cut 12 slots 7-16 in. deep by 3-16 in. wide. This would give approximately the same winding space. One objection to slots instead of round holes is that binding wires are necessary to prevent the armature wires from coming out when running at high speeds.

The finishing touch to the armature core is to chuck it in the lathe and take off a fine chip. This to make it as true of balance as possible. The better the armature is balanced the less will be the vibration when running. This is a very important factor in the machine, as the bearings will last the longer the less the vibration, and screws and nuts will not be always working loose.

The armature can now be prepared for its winding. For each end of the armature there should be made 2 fibre washers about ⅛ in. or 1-16 in. thick, 2½ in. in diameter and cut out in the center to fit, one over the nut and the other over the steel washer at the ends of the core. Holes or slots should be cut in the fiber to correspond with the holes or slots in the core punchings. These are to prevent the sharp corners from cutting the insulation on the windings. Now cut out two round pieces of fairly heavy cotton cloth about 2 in. in diameter. The center of one should be cut out ⅜ in. in diameter and the other 9-16 in. in diameter. These are to cover the nut and steel washer.

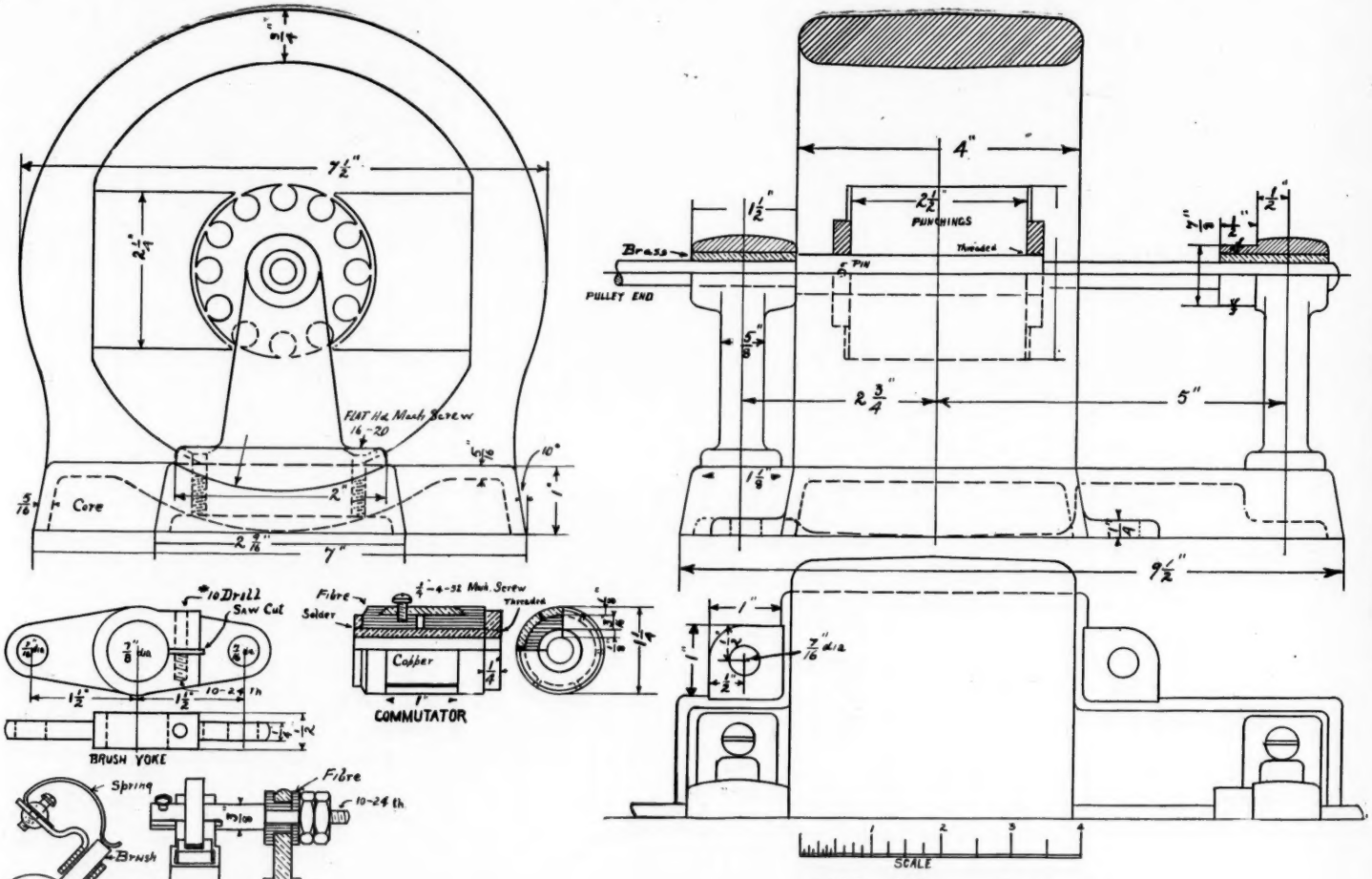
The next thing to make is twelve tubes of white drafting paper to fit in holes of the core. If the armature is slotted, troughs should be made instead of tubes. These should be 3 in. long and with the tubes I would suggest the circumference of the tube be a little greater than that of the tube. The builder will find this of much benefit when he winds the armature, as it will prevent the sharp edges of the iron cutting the insulation as the wire is slipped through. The paper tubes should be well shellacked on the outside and then slipped into place, slitting the ends which project and turning them back against the core. The ends of the core should then be well shellacked and the cloth washers slipped into place, smoothing them down.

The fiber washers should be shellacked on one side and slipped on to be held in place by wire or string threaded through the holes. These fiber pieces will also hold the cloth and paper in place. This work completed, the armature should be set aside to dry. If put beneath the stove or in a very slow oven the drying will be hastened considerably.

While the armature is drying the field spools can be wound. Each pole will require 490 turns of No. 20 single cotton covered magnet wire. This can be wound directly on the pole piece or, what is better, wound on a frame and slipped on the pole completed. The form can be made as follows: Cut a piece of wood just the shape and size of the pole pieces. Its length should be that of the over all lengths of the field spool, which is 1¼ in. Wrap two layers of medium drawing paper around the form, shellacking both layers together. Do not shellac the paper to the form. Then cut the fiber ends for the field. These are made from 1-16 in. stock. The one to go next to the frame will be quite narrow, only ¼ in. wide. Slip those onto the form and screw some pieces of wood on the ends to hold the fiber while winding.

Next put two more layers of paper around the form, using paper wider than the inside space, letting it come up on the fiber. Shellac the paper into place and against the fiber. Drill a hole through the large fiber and close to the bottom, and draw the end of the wire from inside out about 8 in. Now center the form in the lathe and wind. The first seven layers, or until the top of the small fiber end is reached, are wound the full length. After that drop one turn per coil at the small end until the requisite turns are on. Between every six or seven coils I would suggest putting on a layer of paper. This will help to keep the wire even. Give the coil a good coat of shellac and take it off the form, setting it aside to dry. It might be a good idea to see that plenty of shellac gets between the wire and fiber ends and then set the coil up in clamps so that the ends will stick firmly to the wire. Care should be taken that the second coil is wound in the right direction. It should be so wound that the winding in both coils turn in the same direction when in place.

Another good way to make the field spool is to use one turn of sheet tin in place of the first layers of paper. The tin should project out each side of the form and the extra part be bent over so as to hold the fiber ends in place when the coil is taken off the form. The size of wire and turns given require a field current of 1.5 amperes. If the builder is careful it is possible to to get approximately 730 turns of No. 22 wire on the spools, making the inside fiber piece 1 in. wide. This winding would require only 1 ampere of current and is,




# 150 Watt Dynamo

I.M.C. NOV. 1906

therefore, more desirable, giving a machine of higher efficiency. The field coils of No. 22 wire are recommended.

While the field coils are drying the armature may be wound. The wire to be used is No. 16 single cotton covered, and wind 18 wires in each slot. Before winding wrap the enlarged part of the shaft at the pulley end with cloth or tape for about $\frac{3}{8}$ in., and put a fiber tube of $\frac{3}{8}$ inside diameter and $\frac{1}{4}$ in. long on the shaft against the core at the commutator end. These insulate the wire from the shaft, and the fiber tube also serves as a stop for the commutator to bear against. In winding do not exceed the limits of this insulation.

To begin winding, wrap the end of the wire two or three turns around the shaft and go through a slot coming back through the fifth slot to the right, looking at the core from the commutator end. In winding always have this end towards you. Wind on the 18 turns, taking care to have the wires as straight and even as possible and have them lay as tight as possible against the end of the core, remembering the limits set on the shaft for the wire. The wire from the last turn should be twisted into a loop about 2 in. long for material with which to connect to the commutator, and then carried over to the fifth slot beyond. With this slot as number one wind the second coil between this and the fifth slot away. Repeat this operation until all slots are full, when the last turn from the last coil will come in sequence to the loose end of the beginning. Twist these together and there will be six twisted loops sticking out for the armature. Numbering the slots to the right, looking at the commutator end, the coils will come as follows: Coil 1, slots 1-6; coil 2, 11-4; coil 3, 9-2; coil 4, 7-12; coil 5, 5-10, and coil 8, 3-8.

After the wire is all on give the coils a good coat of shellac, especially at the ends and again dry the armature in a slow oven or under the stove. Do not place in too hot an oven as insulation would be likely to charr. In using the single cotton covered wire great care should be taken not to scratch or break the insulation. If the builder could afford it double silk covered magnet wire would be much better. After winding each coil it should be tested with a lamp resistance on 110 volts to see that there is no ground between the coil and the iron core.

The small fittings can be made now while the windings are drying. An easily made commutator for this dynamo is shown on the drawing. The foundation for it is a brass tube $\frac{5}{8}$ in. in diameter and $2\frac{1}{2}$ in. long, bored for a driving fit on the shaft. On one end should be sweated (soldered) a brass washer $\frac{1}{4}$ in. thick and 1 in. in diameter, while the other end should be tapped and fitted with a nut $\frac{1}{4}$ in. thick. The insulation of the commutator is of fiber. Take a piece of fiber and turn it into a piece $1\frac{1}{4}$ in. diameter, $1\frac{1}{8}$ in. long and bored to fit over the tube. In the center turn a groove $\frac{1}{4}$ in. deep and $\frac{1}{4}$ in. wide. Cut the sides of the groove in at an angle, as shown in the drawing.

Next cut the fiber in two about in the middle of the groove. Take a piece of copper tube with inside diameter sufficient to slip over the grooved part of the fiber and a wall at least $\frac{1}{8}$ in. thick. Set this on an arbor and turn the ends at an angle in the fiber making the outside just 1 in. long. The inside will be longer so as to fit under the fiber. Cut the copper tube into six equal parts lengthwise, clean the saw marks and burrs off carefully with a fine file and set the parts between the fiber pieces.

To fill the space between the segments, cut pieces of fiber the shape of the cross section of the copper. Now set the parts together and drill, and tap each of the segments close to one end for a $\frac{1}{4}$ in. 4-32 machine screw. Set the commutator in the lathe and carefully turn the surface down true, but do not take off any more material than necessary. In case the dynamo is is being wound and used for a high voltage I would suggest the spaces between segments be filled with a paste made of powdered mica and shellac which, when dry, is very hard, durable and a good insulator. It will be necessary to also fill the space between the fiber pieces with this paste. Possibly the commutator may have to be wrapped with paper to hold the paste in until it dries.

The brush poke can be cast or cut out of $\frac{1}{4}$ in. brass stock. The dimensions are given on the drawing and can be followed, or the builder can design one which might better suit his fancy. The center hole should be carefully drilled to a running fit on the bearing pedestal. Any type of clamping screw may be used that would draw the sawcut together. A simple and easily made brush holder and rigging is shown in the drawing. The brush holder stud is insulated from the yoke with a fiber bushing and washer, as shown. It has a sawcut at the other end wide enough to admit the brush holder and spring. A machine screw should be fitted at the end to bring the two halves together, clamping the holder in place. The brush holder is of sheet brass, bent into the shape shown. The spring is made of spring brass. The brush is of woven wire $\frac{1}{4}$x$\frac{1}{4}$ in. and about $\frac{3}{8}$ in. long. It should be carefully fitted to the commutator in order to give a good current carrying contact.

The commutator should be assembled on the shaft and connected up to the winding. The loops connected to the next segment beyond the one opposite the coil from which the loop comes. This will bring the brushes in a position which will require the yoke in a horizontal position. Set the brush yoke in position and assemble the armature in place, turning it with the hand to see that it runs freely, then assemble the brushes and adjust the spring.

To drive the dynamo use a pulley $2\frac{1}{2}$ in. in diameter with $1\frac{1}{2}$ in. or 2 in. face and use a $1\frac{1}{4}$ in. flat belt. Connect the field coils in series so that the current will traverse them in the same direction. Connect the outside

wires from the field, one wire to one brush stud and the other to the other brush stud. One of these studs will be the positive and the other the negative terminal of the dynamo.

The machine is now ready to run, but inasmuch as no current has passed through the fields, it is quite probable that it will not generate. It would be well, therefore, to connect the fields to one or two cells of battery in order to get sufficient residual magnetism with which to start the dynamo. If everything is connected up correctly the machine should now generate current. Should it fail to do so try reversing the field leads, or test for an open circuit. As the dynamo will run as a motor a good way to test it is connect it to a battery of 10 or 12 cells, and if everything is right it will run, and turn in the direction in which it should be driven as a dynamo; the only difference being in the position of the brushes. As a generator the brushes will have a lead; that is, it will be ahead of the neutral line of the armature, in the direction of rotation, while as a motor the brushes will lag.

The finish of the dynamo can be made to suit the builders' fancy, a dark green or dark brown enamel or bicycle paint would look very good. The material for this dynamo would cost between $7 and $10, depending upon the facilities the builder has and the proximity to source of supplies. When complete the dynamo should easily be worth $20.

The amount of wire required will be approximately 4½ pounds of either No. 20 or No. 22 for the fields and about 1¼ in. pounds of No. 16 for the armature. To generate 55 volts, wind the armature with No. 20 wire 60 turns per coil. This would require 1¼ pounds of wire. Wind the field with No. 26 wire, 2930 turns per pole. This winding will take ¼ ampere of field current. As a generator with the above winding will give a current of 3 amperes.

# TECHNICAL EDUCATION.

JOHN CASSON WAIT.

Abstracts of Founder's Day Address at the Thos. S. Clarkson School of Technology, Potsdam, N. Y.

The foundation of a technical training consists of nature's laws and phenomena, and as nature's laws are fixed and inexorable, a student possessed of a knowledge of what has been, knows what will be, and it is this that forms the groundwork of the twentieth century system of education. But this is not all; it should go further; it should elevate the new generato a higher plane than mere investigation; it should cultivate powers, a higher ideal and a struggle for genius, the divine, the creative.

An education implies first, a student or scholar to be educated, second, a process or method by which the education is to be acquired, and third, an ulterior purpose or ultimate utilization of the education to some good aim and end.

When the high school or seminary training is finished, several questions present themselves to a young person, among which are three, viz.: 1. What shall I do or become? 2. Shall I attend school or become an apprentice? 3. Shall I enter the general or technical courses of instruction? The first question must be answered by the tastes, qualifications and opportunities possessed by the person. The second question is usually determined by the pecuniary limitation of the person. The third question depends upon the advantages to be secured or benefits to be derived, and is a subject for discussion under our topic.

It is not a new subject, but there may be some new things in it, in the light of another's experience. I do not advocate an extended general course in college as a condition precedent to technical training.

I am no advocate of sixteen years of education before a man or woman becomes self-supporting. He or she is depending too long upon charity or is assuming a debt which he may never repay. It dwarfs the spirit of independence and self reliance which the twentieth century needs so much. A young man who accepts his parents' or relatives' support to the age of twenty-four or twenty-six years has forfeited one of the heavenly attributes of human character, that of manly self-reliance. I would not expect great things of such a young man. If not blessed with influential relatives or friends he must gain his experience and acquire a clientele. His married life is postponed and his ideal life shortened by a decade.

* * * * * * * * *

In the general courses the studies that you pursue are determined, in the larger universities, by the student's own election. The tendency is towards this plan. By it the student may take his collegiate course and at the same time pursue courses required in the professional classes. This will lead to the three years' collegiate course and is a step in the right direction, if the work of the student be directed or supervised. If he be required to elect this profession or business and to take subjects prescribed or acknowledged to be advan.ageous in the vocation adopted, then it is, to my mind, most desirable. If he elect the elementary subjects in the various departments, acquire what is popularly known as general culture and secure the requisite number of points or half courses, he can graduate with a degree, though that may mean posi-

tively nothing as an indication of what the student knows.

There is the choice of schools to consider; the large and the small, those in cities, in the country, the general and the technical. But outside of these there are also for consideration the systems that prevail. Some of the schools believe in pursuing several subjects at once, while others pursue one or two subjects only at at a time. The various systems have many advocates. Each maintains that its system is the system. There is the choice between the elective and the prescribed courses of study, the experimental and the theoretical systems of teaching sciences.

In my opinion, it is these institutions which combine the theoretical and the practical, which limit to a moderate degree the number of courses, which prescribe courses for lower classmen, and upper classmen, and leave the election to upper classmen, that truly derive the benefits of both systems.

Cultivate exquisite care and practise heroic effort. As our country grows older and competition becomes greater, the requirements of an education increase. Students who expect and hope to excel in the competition that prevails in our great cities, must have something better or something different from that possessed by others.

Refinement should be applied to all that you do and undertake. Your mental training should be refined on the same plan. That is what makes the artist; it is what distinguishes the actor and soldier from the business man or laborer, and it is what makes the successful technician or engineer in the present day.

Technical training, as offered by our industrial schools, tends to develop abnormally particular lines of the intellect and greatly enlarges the scope of one's observations and power in certain directions. Such a development has been compared to the abnormal development of the five senses. Yet the world has need of such men. He may not be wanted frequently, but occasionly his services are required when they command great prices.

The prevailing idea is that a complete education should be acquired at school. The average graduate from college or technical school hails his degree as the final goal of his educational ambitions. Few study or expect to study after graduation except, perhaps, in short crams for a civil service or professional examination.

Such is not the object. The school's aim is to qualify you to study. If you do not continue with your studies you are soon going backward and at a rate which will appall you when you come into competition with some recent graduate fresh from his studies.

A far-seeing man will, before spending very much time or money for a thing, enquire what specific uses he will make of it, and he will select the object of his purchase with a view to its qualities and its adaptations. A young man who enters college or a technical school, should have some idea of what his tastes and capacities are and should be directed in the lines where his abilities would be best applied and cultivated. I am not one to advise that every man should be a perfect man; neither do I advocate that a whimsical and indolent youth should be permitted to escape essential training in mathematics and the sciences by his declaration that he does not like them and he does like music, art and other subjects which gain flattery and applause. Yet for one's life work it is a grave misfortune for one to school himself or herself in a business for which they have not a real liking and to which they cannot bring enthusiasm. Elect something to your liking and something in which there are opportunities and for which there is a demand.

The utilization of technical training in the industrial pursuits and development is everywhere apparent in this country. To no other one element are the country and the people more indebted for their wealth and prosperity. The physical comforts at home, of business and of travel are due to the marvelous provision of the technician.

The economic value of this training is illustrated by the trade, domestic as well as foreign. No country can have claims to world power until it develops the industrial talents of its people and the natural resources of the land. The balance of power remains where the scientific, industrial and mechanical arts are best treated.

---

A writer in "Popular Mechanics" recently explained his method of overcoming the difficulty of making paint adhere to zinc, his desire being to make zinc be the support of a plate surface, and painting the surface with a paint composed of shellac in alcohol containing a solution of pumice stone and lampblack. The method employed was as follows:

A portion of the 'paint' was diluted with alcohol and the surface of the zinc well sand-papered while thoroughly wet with the solution—the intention being not to allow any of the surface to come in contact with the air during or after the operation of sand-papering. The paint was thick enough to cover thoroughly as it dried. When every part had been gone over thoroughly, a number of coats were added, in order that the low places might be filled up and the surface ground with pumice stone. Time has proved the success of this experiment. Many years have gone by, but the coating holds perfectly and the matter is now brought forward with the hope that the suggestion may have useful application in ordinary painting.

The theory on which this experiment was based is that zinc oxidizes instantly wherever a fresh surface is exposed to the air. This oxide is so thin that it is not visible. Nevertheless, it is present, and forms an unstable attachment for the paint as commonly applied, thus preventing the same from coming in absolute contact with the metal itself. The sand-papering operation, under cover of the wet paint, produces a different condition of things.

# A WINDOW CONSERVATORY.

JOHN F. ADAMS.

The arrangement for winter plants here described is the result of much planning to obtain considerable more room for plants than could be spared conveniently inside the room to which it was fitted. As will be seen from Fig. 1, it is much like a small bay-window, and is attached to the outside of the house, thus affording room for quite a large stock of plants without infringing upon the interior of the house. It is located against a window on the sunny side of the house, the sash of which is removed, care being taken to prevent the window cords from running through the pulleys by tying knots in them. In the more northerly and colder states it will be advisable to fit curtains, which are lowered on extremely cold nights, and in addition, a small lamp may be used for heating. During much of the time, however, the heat from the adjacent room will be quite sufficient for most kinds of plants.

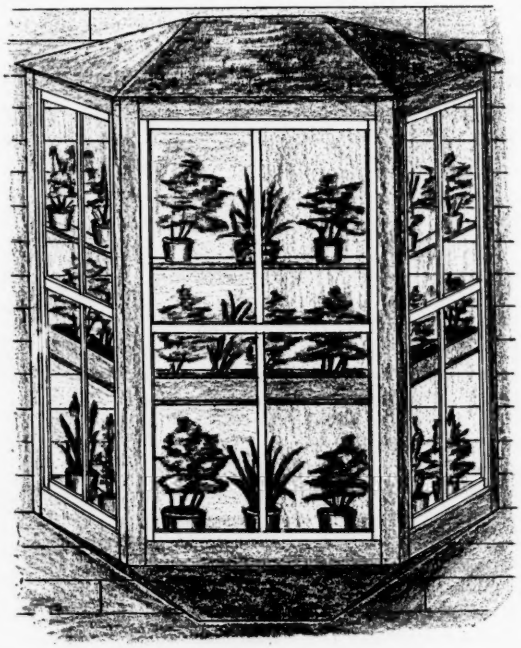


FIG. 1.

It will hardly be possible to give exact dimensions, owing to the great variation in the sizes of the windows to which such a frame can be fitted. The first requirement is to make a dimensioned drawing of the window to be used; then purchase one full-size and two half-size outside windows, the larger one having a sliding pane, which may be opened for ventilation whenever the weather is mild.

A framework is then made of 2 x 3 in. planed spruce, as shown in Fig. 2. The ends are first made with halved joints for the front cross pieces. In the ends of the vertical pieces tenons are cut as in Fig. 3. It will be noted that the outer end edges of the vertical pieces are bevelled to the angle formed by the side. The windows fit snugly between the various pieces of the frame, the front edge of which is from 12 to 15 in. from the rear edge against the side of the house, varying according to the size of the windows used. The ends of the cross pieces connecting the ends are halved, as before mentioned, and attached with strong wood screws.

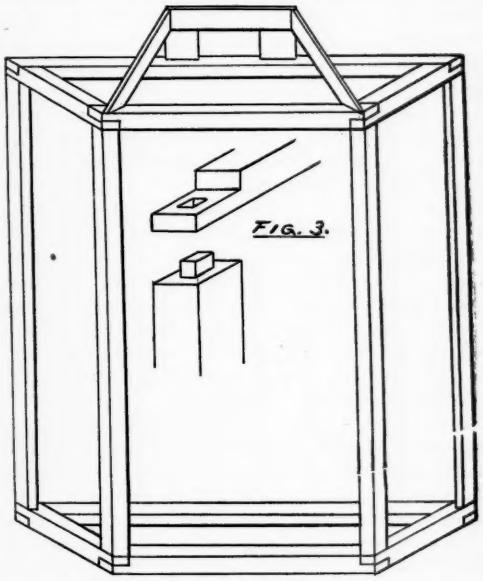



FIG 2.

The under side may be covered with matched sheathing, planed both sides, or splayed as shown in Fig. 1. In the former case the work is done before the frame is attached to the house; but if splayed the work must be done in place to secure accurate fit and tight joints which is also true of the top. That part of the frame of the top, and also of the bottom, if splayed, which is attached to the rear cross piece must also be cut out and fastened in place. The height in the clear is about 6 in. and length about one-third that of the width of the window.

The frame is then firmly attached to the side of the house, using small angle irons for the purpose and screws long enough to reach through the clapboards into the siding. The weight of the window, when loaded with plants, is considerable, and ample strength should be secured by using plenty of angle irons.

The roof, of matched sheathing, is then added, the lengths of board being sufficient to give an overhang of about 3 in. A smooth surface is desirable, as roofing paper is to be used for the final covering. This can be obtained of any hardware dealer, together with directions for laying. The chief difficulty will be to secure a tight fit between the boards at the rear edge and the clapboards on the house, and in addition to accurate marking, considerable "cut and try" work will be needed. After the roof is covered with the roofing paper, a strip of electrician's tape can be used to cover the joint with the house, which will prevent rain or melting snow from entering.

The frame is then completed by putting on strips 3 or 4 in. wide, on the outside forming a casing much like the outside of any window. It should lap over the edges of the timber frame work about ¼ in. The joints at the corners will have to be bevelled, and it will be advisable to halve the joints between the vertical and cross pieces. Tight joints are absolutely necessary to exclude both cold and rain.

The windows may now be put in, fastening with a few screws, or strips of wood may be fastened to the wood frame with screws, this method being preferable, as it makes an additional break to the joint. If the joints are not then tight enough to keep out the cold, run electricians tape around all the joints, which will completely close them; in fact, it is desirable to do this as some of the joints are liable to open up during a winter.

Curtains are next to be fitted and then the shelves, either three or four in number, according to the size of the plants to be grown. The shelves, 6 or 7 inches wide, are put up on brackets or large angle irons. By cutting the ends where they join to an angle, a screw can be put through the bracket into the ends of each shelf.

It will also be found desirable, in place of flower pots to use wooden boxes about 6 or 7 inches wide and deep, and filled three-quarters full of rich loam. The boxes at the large window reach clear across; those at the ends having one end cut to a mitre to fit without loss of room. These boxes are most attractive when painted green. On the top shelf, the plants are best handled if in pots, as it is not convenient to handle boxes so high.

Nothing has been said about painting, this, of course, being determined by that on the house. A priming coat of lead paint is necessary before putting on the last coat. A pleasing selection of colors is to paint the windows to match those on the house, and the woodwork to match the trimmings.

---

Renew your subscription before you forget it.

## HOW TO COLOR BRASS BLACK.

To produce a black color on brass, the following is the formula: Dissolve 1 pound of plastic carbonate of copper in 2 gallons of strong ammonia; first boil the brass that is to be blackened in a strong potash solution to remove all grease and oil; rinse well and dip in the copper and ammonia solution, which should be heated to 150 to 175° F., until the desired degree of blackness is acquired. The color produced is very uniform and has little tendency to peel off. The process works best on brass containing much copper, or on what is known as "red" brass. Directions are also given for making the plastic carbonate of copper as follows: Blue vitriol (sulphate of copper) is dissolved in hot water, and a strong solution of common washing soda is added to it so long as any precipitate forms. The precipitate is allowed to settle and the clear liquid is poured off. Hot water is now added and the mass stirred and again allowed to settle. Again the clear water is poured off and the operation of adding hot water, settling and pouring off is repeated until everything has been washed out of the green carbonate of copper which remains at the bottom of the vessel. This is the plastic carbonate of copper referred to.

---

## THE TURQUOISE.

The turquoise runs in blue veins through the rocks, with now and then the concretions called nuggets, which afford stones of value. At the present time the bulk of the world's supply of fine turquoise is drawn from New Mexico, and experts say that that the output is equal to the best turquoise from Persia. Indeed, it is in one respect superior, holding its color better. About $200,000 worth of turquoise are sold annually. For the first time in centuries it is possible, jewelers say, to make a turquoise necklace of perfectly matched stones. The turquoise occurs in a rock of a pretty reddish color, being so mixed up with it ordinarily as to be valueless. But the idea came to a gem expert in New York not long ago that it would be a good idea to take selected pieces of this stuff and polish them, offering them for sale under the name of matrix turquoise. To his own astonishment, the idea proved immensely popular; a fad for stones of this kind rapidly grew; and today, following out the same idea, jewelers sell matrix sapphires, matrix emerals, and matrix rubies. In fact, almost any flawed gem, filled in with ordinary rock stuff and impossible for cutting, will bring a high price as genuine matrix.

---

That quartz is opaque is due largely to the myriad cavities which it contains. These cavities may be vacant, but often they contain water and liquified carbonic acid gas. Sorby discovered the fact that they may be so microscopic in size that a thousand millions of them in a cubic inch is not unusual, and the enclosed water often constitutes one to two per cent of the volume of the quartz.

# A TWENTY FIVE FOOT AUXILIARY YAWL.

CARL H. CLARK.

## II. Making and Setting Up the Stem, Stern and Bottom.

The outline of the sternboard having been shown in Fig. 6, the complete stern is shown in Fig. 8. It is of 1¼ in. oak or other hard wood, fastened together with cleats 1¼ in. thick. It should be formed of a wide piece in the middle, narrower pieces added on the sides to make the necessary width. No joint should come in the middle, as it would make fastening difficult. The cleats are fastened on with galvanized boat nails, and the lower cleat should be at least 15 in. from the lower end, to allow fastening of the stern knee. The round of the upper end need not be cut at present, neither need it be bevelled until set up in place.

about ⅝ in. deep and about 1½ in. wide. It need only be roughed out now, leaving the finishing to be done after it is in place. The upper end should be left about 6 in. larger than shown, to fasten shores to hold it in place. The flat part outside of the rabbet may also be bevelled off, as shown, to about ⅜ in. on the face.

The outline of the bottom is shown in Fig. 10, and the complete bottom in Fig. 11. It is 1¼ in. thick and is best made in three pieces, joined as shown. The pieces are planed on the edges and fitted together. If necessary, two or three temporary cleats may be fas-

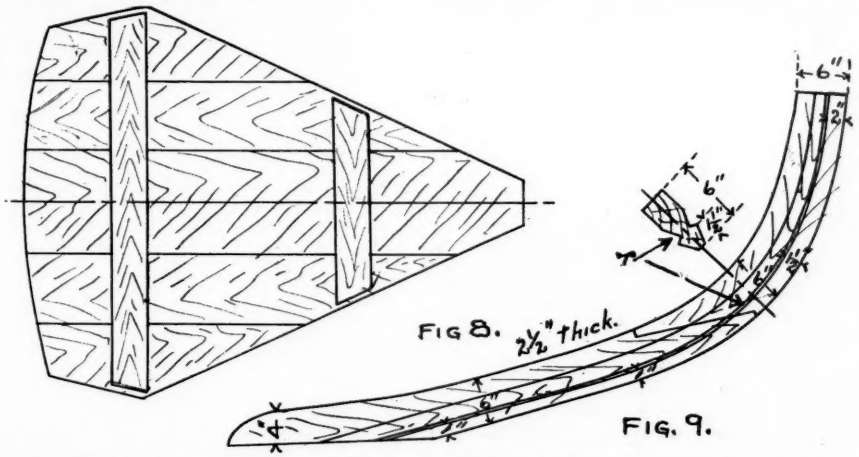



FIG 8. 2½" thick.

FIG. 9.

Fig. 9 shows the completed stem, the outline of which is given in Fig. 6. It is 2½ in. thick. While it may be possible to obtain a curved piece out of which it may be cut, it is not likely; therefore it will probably be made in two parts scarphed as shown in the figure. The length of the straight part of the scarph should not be less than 10 in., and its exact position will depend upon the stock obtainable. The two portions are cut out separately and fitted together to match the paper pattern already laid out. They are fastened together with pieces of ⅝ in. galvanized rod riveted over washers inside and outside.

In Fig. 9 *r* represents the rabbet or triangular groove to take the ends of the plank and bring them in flush with the sides of the stem. The dimensions for laying out this rabbet are given from the face of the stem; these are laid off on both sides and a curve drawn through them. Starting with this line the groove is cut as shown in the small cross section, being

tened on to hold them; a center line is struck and the mould points, 3 feet apart, are laid off along it and lines drawn across. The widths from Fig. 10 are now laid off on each line as shown; a fair line may be drawn through these points by using a batten about ¾ in. square, held in place by rails driven each side of it. The center-board slot should also be laid out.

The boards may now be separated and trimmed down to the line, leaving a square edge. The slot may be cut by boring a few holes near one end sufficient to be sawed out, and then trimmed up with a chisel. The boards are then fastened together permanently by the cleats, as in Fig. 11. These cleats are of oak 2 in. square and about 6 in. longer than the width of the bottom.

The positions of the cleats are as shown, and they all extend across the bottom except the two between moulds 3 and 4, which are cut 2½ in. clear of the centerboard slot. The cleats are square with the cen-

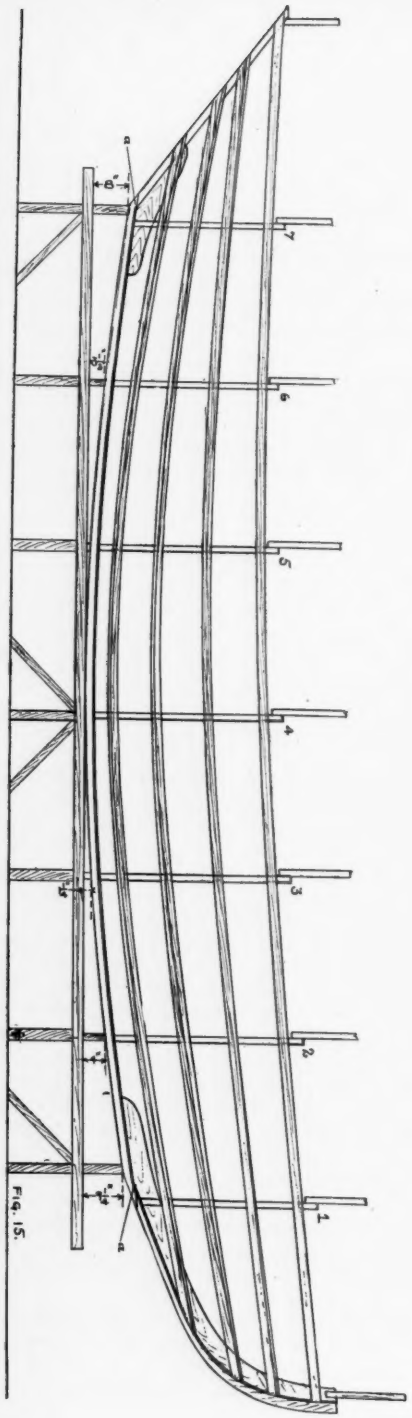



Fig. 15.

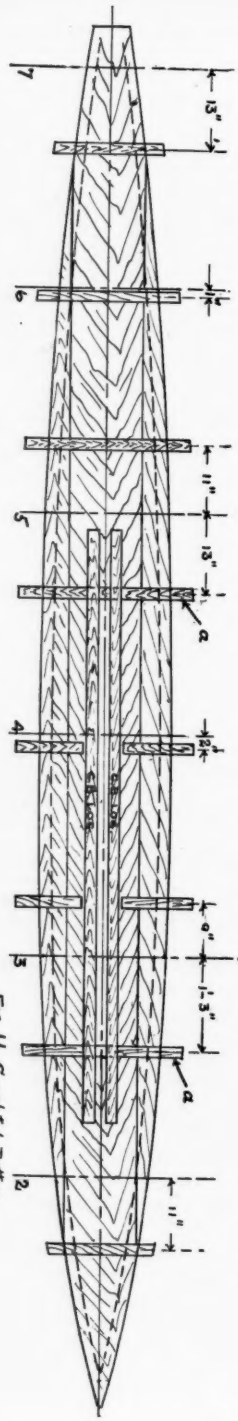



Fig. 11. Completed Bottom.

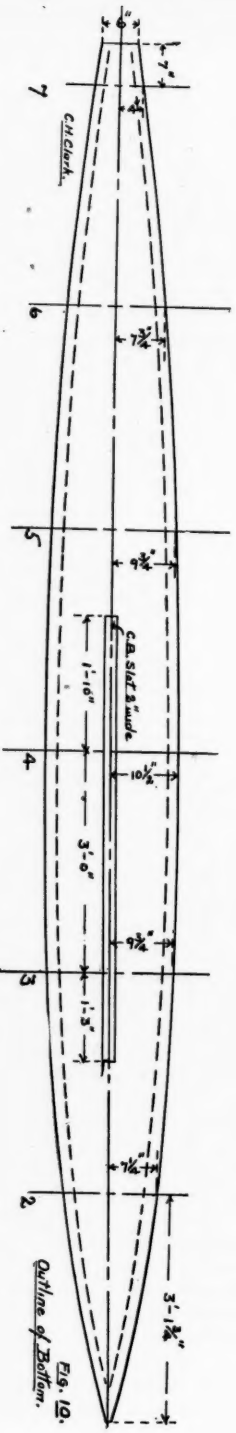



Fig. 10. Outline of Bottom.

ter line, and are fastened on with heavy galvanized nails or screws. They should be put on in about the position shown in order to clear the other frames; those marked *a a* are exactly even with the ends of the centerboard slot.

The bottom may now be turned on edge and a rabbet cut out on the edge, as shown in Fig. 12, using a mallet and heavy chisel. Near the ends it should be cut rather steeper than shown on account of the sharper angle of the frames. This may be accomplished by reducing the 1¼ in. dimension to 1⅛, and finally to 1 in., the others remaining the same. While this rabbet must be carefully cut, it need not be entirely finished now, as there will be small variations of the angle which cannot be determined until the boat is set up.

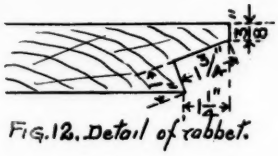


Fig. 12. Detail of rabbet.

The stern house, shown in Fig. 14, should be cut to the dimensions given, out of a piece of 3½ in. stock with the grain running from point to point. The exact angle of this knee is quite important, as it fixes the angle of the sternboard, and consequently the shape of the after end of the boat.

The stern and sternboard are now set up in their proper positions on the bottom and clamped temporarily in place; the center line of each must agree with that of the bottom and they must be in the correct fore and aft line or, in other words, point directly ahead and astern, and not to one side. To aid in setting these, the bottom may be laid on a level floor, and a cord stretched from the center of the sternboard to the center of the stem.

A short plumb line may then be held alongside of this cord, and the coincidence or deviations of the point of the bob with the center line of the bottom will show whether they are correctly set. When properly adjusted they may be fastened into place with ⅝ in. galvanized iron rivets. Rivets for this and other purposes may be bought with the head already formed, or may be formed of a piece of ⅝ in. rod sawed the proper length and headed at either end; the latter is the cheaper way and just as satisfactory.

A foundation must now be built upon which to set up the boat in order to bring it to a convenient height for working. This foundation is built as shown in Fig. 15, of a 2 in. spruce plank about 12 in. wide and 20 ft. long, supported about 15 in. above the floor. The supports or braces are pieces of 2 in. plank shaped as in Fig. 16, or other shape which is sufficiently rigid. These supports should be so spaced that one comes under each end and under each mould, as in Fig. 15.

For building the boat a place should be chosen, if possible, where there is a wood floor and strong rafters overhead, as both of these are necessary for ease of bracing and holding the several parts. The foundation should now be set up in the place chosen; it must be strongly built and well braced, both sidewise and fore and aft. The upper surface must also be straight and level both ways.

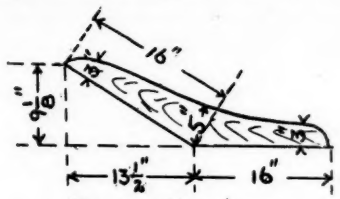


Fig. 14. Stern knee.

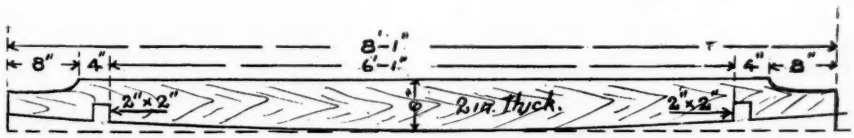


Fig. 13 Outline of C.B. Legs.

The bottom, with the attached stem and sternboard must now be bent in as in Fig. 15. Blocks are cut to the widths there given, which are fastened to the foundation in the proper places. The bottom is laid on and forced down into the shape thus prepared by shores from the beams above; the judicious use of wedges will help in this operation. The bottom is bent down until it touches the foundation at the middle brace. This operation will require some care, as the bottom is a fairly stiff piece of timber and will require some force to bend it. Owing, also, to the stock which has been cut out at the centerboard slot it will have a tendency to bend more easily at this point, which must be guarded against. A liberal amount of boiling water poured over the bottom, or cloths saturated with hot water, will take out some of the stiffness and allow it to bend more easily.

An ample number of shores should be used and the final shoring should be placed on either side of the center line, leaving a clear sight down the middle of the boat. The shores must also be kept clear of the mould points.

The moulds, which have already been made, may then be set up in their right places on the bottom, the

lower edge of each being slightly bevelled to fit the slope of the bottom at each mould. It is to be noted that the moulds forward of No. 4 are placed forward of the mould point, or with the mould point even with the after face of the mould, and those aft of No. 4 are placed aft of the mould point.

The moulds must be set plumb and also square with the center line fore and aft and must also have their middle points in the center line. The line already used may be again stretched and the moulds adjusted so that the center point already marked on the cross piece will fall under it. As each mould is adjusted it is fastened by braces, as shown in Fig. 16, run diagonally to the beams overhead. The moulds are fastened to the bottom by cleats nailed to both mould and bottom, and by nails driven in diagonally.

The correctness of the slant of the stem and sternboard may be tested now; the distance from mould point No. 1 to the rabbet at the top of the stem is 3 ft. 8 in. as given in Fig. 2, and from mould point No. 7 to the corresponding point on the sternboard is 4 ft. 1 in.

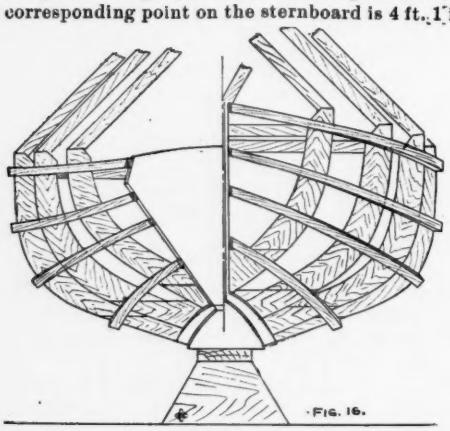


FIG. 16.

The angle of the sternboard with a level line should be such that by measuring up along the sternboard 3 ft. from the bottom corner and dropping a plumb the horizontal distance from the corner to this plumb line will be 2 ft. 4½ in.

The stem and sternboard are also well braced so as not to be thrown out of line during the process of building.

A ribband about 2 in. wide and 1 in. thick is now bent around the moulds near the top and fastened in place. As it is bent around, a portion of the edge of each mould is bevelled to allow it to bear evenly on the entire thickness of the mould.

The entire edge of each mould may now be bevelled so that the ribbands, run as in Figs. 15 and 16, will bear evenly at all points. The fairness of the different moulds may now be tested, as the ribbands should bear evenly on every mould and make a fair sweep from stem to stern. Any unfair spots may be corrected, either by trimming off or shimming out as may be necessary.

The rabbet in the bottom and around the stem may be finished out to the correct angle and made ready to receive the plank. The angle of both of these must be such that a plank lying on the moulds will bed fairly into the rabbet at all points. The edge of the sternboard also must be bevelled to the right angle. When this work is completed three or four additional ribbands are bent around when the boat should look as shown in Figs. 15 and 16. Screws should be used, as the ribbands must be removed from time to time.

At the points *a a*, Fig. 15, where the stern and sternboard join the bottom, stop-waters are to be fitted to prevent the water running in along the joint. A 5-16 hole is bored right through, and a tightly fitting plug driven in and cut off even with the outside surface.

---

## METHOD OF OBTAINING EXPERIMENTAL WAVE LENGTHS.

There is a considerable gap of unexplored wavelengths intermediate between these of Hertzian waves and what is commonly known as heat. The shortest Hertzian waves which have heretofore been produced are of the order of one millimetre in length. In this communication Prof. Reginald A. Fessenden describes a method of obtaining waves of intermediate length. The method was discovered by the author some years ago, but he has been unable to carry on any work with it. If two copper rods are placed against the plane surfaces of two plano convex lenses having the convex surface directed toward each other and separated by a very short air-gap, and are charged from a source of high potential, discharges will take place across the gap between the lenses, and these discharges will have short wave-lengths. If the lenses be replaced by metallic bodies the capacity of the system will be considerably increased and the wavelengths considerably lengthened. But with glass lenses, as described, the wave-lengths of but a few ten-thousandths of an inch are obtained, and there appears to be no necessary limit to the frequency. Inert gases of the helium type seem to give the best results, but good results are obtained by using quartz lenses in air. Quartz is used because it does not seem to become conducting when heated by the passage of the discharge, as does gas. For this reason the wave-length remains more constant.—"Nature."

---

The deepest hole in the world is one that is located near Leipsig, Germany. The object of the hole was in determining whether coal was there and likewise the man making the boring was of a scientific turn of mind. The hole has attained the great depth of 5790 feet. At the surface the hole was about half a foot in diameter, and at the bottom had tapered off to less than an inch in diameter. Diamond drills were used and the rods weighed 20 tons. It took ten hours' work to take the rods apart and put them together again.

# SECRET OF AERIAL NAVIGATION.

The Tissandier brothers of France moved an airship by means of electricity generated by bichromate of potash cells. Redard and Krebs of Germany also attempted the feat of governing the motion of a huge gas bag through the circumambient atmosphere. Electricity from batteries, power from steam and gas engines, and finally energy from the very air itself, represents the efforts made to build a useful, reliable and consequently durable air ship. Like an ignis fatuus it has been dancing before the eyes of the public for more than a century as a thing apparently within our clutch, yet constantly evading us. But the record of advancement in this field has at least been the record of engineering efforts to create a definite machine.

From this standpoint the air-ship problem is no longer confined to any haphazard class of experimenters in the strict sense of the word. But it may be regarded as a possible development in the field of mechanical or electrical engineering. It may be expected to develop greatly in the very near future; and it is therefore imperative to keep in touch with its various phases of growth in order to appreciate the science, the art and the logic which culminate in its successful issue. Electricity has had a hand in its development, though of late it has been superseded by the gasoline and steam engine, for the simple reason that, pound for pound, including the source of power—fuel and water or both—the motor and batteries are out of the race. As an ignition feature of the gasoline engine, electricity cannot be safely dispensed with. With all this preamble though, the problem arranges itself into three parts. The gas bag providing the flotative force coming first, and which though strongly made today does not differ fundamentally from that sent up in the air by the Montgolfier brothers many years ago.

The steerable or dirigible balloon comes next; of which, perhaps, the Santos Dumont type is most characteristic at the present time, and to which the ship of the Tissandier brothers belonged. The last is of the aeroplane type, developed to a remarkable extent by Prof. Langley of the Smithsonian Institution. Thus the air-ship has passed through three stages of growth, which can be divided, however, into two distinct fields of experiment. The older field follows along the lines indicated by the use of a self-flotative body such as a balloon. The newer field takes the bird as a model and attempts success with a non-flotative but withal self-supporting machine, essentially heavier than its own bulk of air.

An investigation of this latter class of machines discloses one elusive feature. They are able to rise into the air only in the teeth of the wind. The supporting element is therefore derived from this source, and according to such authorities we have, birds themselves, of the so-called soaring class, rise or support themselves in this manner. The swift winging class, however. represent a curious anomaly, in that their weight represents, a much greater wing surface than the heavier soaring birds. To quote from R. Von Lindenfields's remarks in the conclusion of an article by him, whose data was obtained from measurements of the weight and wing surface of flying creatures of all descriptions and embodied in an article called "Relation of Wing Surface to Weight": "According to the foregoing, if the combined weight of the body and the mechanical flying apparatus amounts to 90 kilograms, 198 pounds, in order to sail like an albatross a man would require 90,000 times 30, or 2,700,000 square millimeters of wing surface; that is to say, two wings furnishing together 2.7 square meters, 20 square feet of surface."

In conclusion it may be stated that the value of such information is entirely dependent upon the drift of experimentation. At present the imitation of the bird is the basis of all activity in this field. That it is a heavy body that readily supports itself in the free air with little effort is obvious. For this reason we must look to air currents for the source of its flotative power, more than its wing effort. But the fact that it springs into the air when it operates its wings—and if a soaring bird, does not stop flapping until it reaches a certain point in the air—shows clearly that the power of a flying machine will only be greatly called upon to raise it into the air to a certain height. At this point the navigator will be required to find an air current to bear his ship, and in particular will be forced to exercise skill to preserve its position in space.

Along these lines, aerial navigation will probably be carried out, when the secret of construction and control are a little better crystalized than at present.

---

Coals are classified upon the ratios which the volatile materials or hydro-carbons bear to fixed carbon. Anthracite coal is low in volatile material and high in fixed carbon. Soft coals are high in volatile matter and low in carbon. The percentage of coal in volatile hydrocarbons runs as follows:

| | |
|---|---|
| Anthracite | 3.6 |
| Semi-anthracite | 6.12 |
| Semi-bituminous | 12.18 |
| Bituminous | 18.50 |

The remaining components of the coals are absorbed moisture, fixed carbon and ash. The ash in a first class coal should not be above 8 per cent.

---

The so-called sulphur springs, those whose waters are of bad taste and odor, are not really sulphur springs, they getting their odor and taste from the hydrogen sulphide contained therein.

# AMATEUR WORK.

**DRAPER PUBLISHING CO., Publishers,**

**88 Broad St., Room 522, Boston, Mass.**

**A Monthly Magazine of the Useful Arts and Sciences. Published on the first of each month for the benefit and instruction of the amateur worker.**

**Subscription rates for the United States, Canada, Mexico, Cuba, Porto Rico, $1.00 per year.**

**Single copies of back numbers, 10 cents each.**

**TO ADVERTISERS.**

**New advertisements or changes, intended for a particular issue, must be received at this office on or before the 10th. of the previous month.**

**Entered at the Post Office, Boston, as second class mail matter, Jan. 14, 1902.**

## DECEMBER, 1906.


In this issue will be found a design and description of a 150 watt dynamo, the first of a series of articles by Mr. Ira M. Cushing, E. E. Other sizes of the same design to be described are: 75, 300 and 550 watt; the latter size being especially adapted to a small, isolated house-lighting outfit. In connection with the description of this size will be given full directions for installing and operating the auxilliary instruments necessary to such a plant. Mr. Cushing is also preparing a series of articles on "Elements of Dynamo Design," which will be very complete, and yet without the abundance of mathematical formula generally found in text-books. For that reason they will be of special interest and value to electrical students who have not the advantage of a technical college training. We are confident these articles will interest a large number of our readers.

With either the January or February issue the size and scope of the magazine will be increased by several pages. In this connection we would call attention to the fact that, owing to the size of pages and the type used, the volume of reading matter that is at present being given is fully equal to that of a number of the popular magazines sold at the same price, but which, using larger type and for that reason having more pages of a smaller size, seem to give more matter, while not actually doing so. It is also a fact that technical writers receive a much higher rate of payment than is given for general literary matter, a matter of decided importance to the publisher, although often overlooked by the reader. We feel, therefore, that the magazine, even at present, and especially when increased in size, gives an ample return for the moderate subscription charged. That this is also the view of many of our readers is evidenced by the many complimentary expressions found in our correspondence.

We are constantly learning of some excellent devices or constructive work made by readers, but are not always able to induce the makers to prepare descriptions for publication as quickly as desired. To secure a quick and large response from those who can supply interesting articles, we offer the following liberal prizes for the best descriptions suitable for publication in the magazine: First prize, $25.00; second prize, $15.00, and third prize, $10.00. Other prize offers for special subjects will be offered later, but this one will be open to all classes of workers. For acceptable articles received, but which are not awarded a prize, regular space rates will be paid. All articles intended for this competition must be received not later than Dec. 20, 1906. The right is reserved to withhold any or all of the prizes should the articles offered not be deemed of sufficient merit to entitle them to prizes, calculated on the basis of double regular space rates. Articles, to be acceptable, must describe how to make something which would be of interest to a reasonable number of readers. All accepted articles to be the sole property of the magazine. Here is a chance to secure your Christmas presents if you set about it promptly.

---

A remarkable achievement in wireless telegraphy is reported in the Navy Department from the Pensacola station. This plant has been able to keep in constant communication with the United Fruit Company's steamer Preston from the time that vessel left New York until it arrived at Honduras. The station also received messages from the Preston while she was entering New York harbor, where she was undoubtedly bathed in electric waves from other stations and ships. A curious fact is that the Pensacola station has not been able to repeat this performance with any other steamer than the Preston, notwithstanding the fact that the plants are alike on all of the United Fruit liners.

---

Fuller's earth consists of clay mixed with just enough fine silicious material to take away the plastic properties, so that it disintegrates into powder mixed with water.

# CONSTRUCTION AND MANAGEMENT OF GASOLINE ENGINES.

CARL H. CLARK.

## VII. Spark Coils—Wiring Diagrams.

COILS.

Coils for use with gasoline or gas engines are of two kinds, the plain coil illustrated in Fig. 40, and the induction coil shown in Fig. 41. The former is used in connection with the make and break ignition, and the latter with the jump spark system.

The plain coil shown in Fig. 40, consists of a core or bundle of soft iron wires *C*, surrounded with a coil, *W*, of rather coarse wire. While only one layer is shown, there are in reality several layers, one over another.

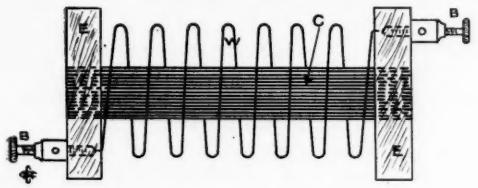



FIG. 40.

The ends, *E E*, are of wood, and hold the binding posts, *B B*, to which the ends of the coil of wire *W* are fastened. The complete spark coil will thus be seen to consist simply of a continuous coil of wire surrounding the iron core. The coil is introduced into the battery circuit, and the current simply passes through it. As to the electrical action of the coil, it will be sufficient to say that the passing of the current around the iron core greatly intensifies the spark at the breaking of the circuit.

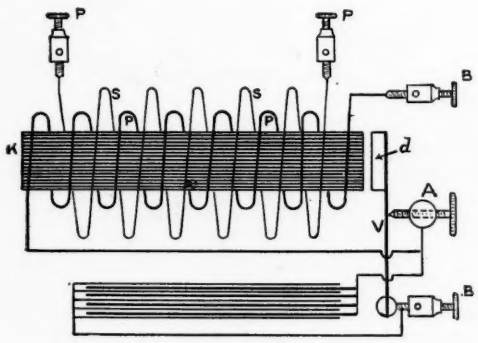



FIG. 41.

Fig. 41 shows a diagram of a jump spark or induction coil. This coil is quite similar in principle to the ordinary induction or medical coil. It consists of a core of soft iron wire, surrounded by a primary winding, *P*, made up of two or three layers of coarse wire. Outside of this winding, and thoroughly insulated from it, is the secondary winding *S*, made up of many turns of very fine wire. Each time that the current is made or broken in the primary coil a corresponding current tends to flow in the secondary. If, then, the terminals of the secondary coil are connected to a spark plug, a spark will pass each time the circuit is made or broken in the primary. The terminals of the primary coil are connected to the binding posts *B B*, and those of the secondary to the posts, *P P*. During action of the coil, the iron core is alternately magnetized and demagnetized by the passage of the primary current. The vibrator spring *V* is fastened at its lower end, and on its upper end carries the iron disc *d*, which stands opposite to and a short distance away from the end of the iron core. The vibrator adjusting screw *A* bears against the vibrator *V*. One terminal of the primary is connected to the adjusting screw *A*, and the stationary end of the vibrator is electrically connected to one of the binding posts, *B*. If, then, the battery terminals are connected to the posts *B B*, a continuous circuit is formed through the vibrator spring, adjusting screw and primary coil, allowing the current to flow through the primary coil, and by induction setting up a current through the secondary coil.

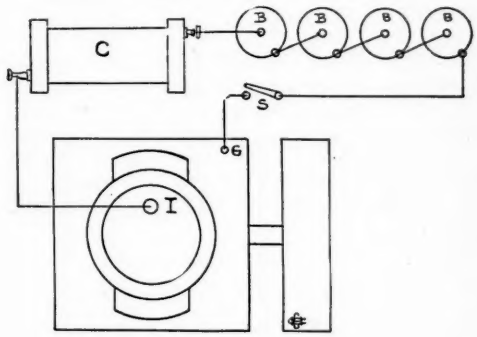



FIG. 42.

The flowing of the current around the iron core magnetizes it and causes it to attract the iron disc or armature *d*, thus drawing the vibrator out of contact with the adjusting screw *A* and breaking the circuit, causing a current to pass through the secondary in the opposite direction. The breaking of the primary cur-

rent also causes the demagnetization of the iron core, releasing the disc *d* and allowing the vibrator to spring back into contact with the screw *A*, again completing the primary circuit and allowing the previous action to be repeated. This automatic interruption of the primary circuit, which is extremely rapid, causes a series of alternating currents to pass through the sec-

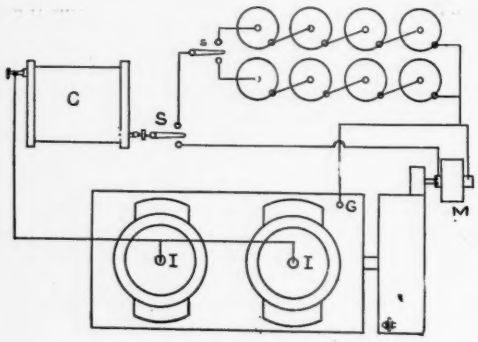



FIG. 43.

ondary, and if the spark plug is connected to the terminals *P P*, a rapid series of sparks will pass. Owing to certain electrical effects, the current passing the secondary coil when the primary circuit is completed, or at the "make," is not as strong as that which passes when the primary circuit is broken, and it is the sparks caused by the latter which is visible in action.

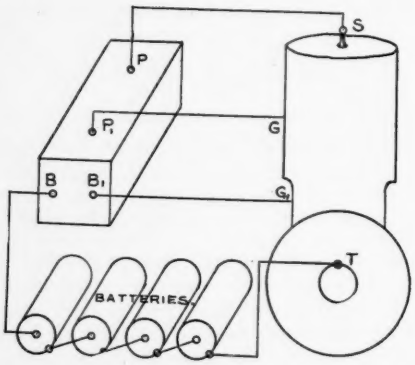



FIG. 44.

The current in the primary circuit is of small voltage and of relatively larger volume, while that in the secondary is of extremely high voltage and of small volume. The relative proportions of the two are regulated by the size and amount of the wire in the two coils.

A condenser is shown at *C*, consisting of layers of tin foil, insulated from each other, alternate sheets of which are connected to two terminals, which terminals are connected, as shown, with the vibrator screw and the terminal *B*. The electrical action of the condenser need not be dwelt upon here, except to say that it greatly intensifies the spark at the "break." The entire coil is enclosed in a box with only the binding posts and vibrator in sight.

BATTERIES.

The ordinary form of dry battery or some form of liquid battery may be used, as desired. The latter are supposed to be more reliable than the former, and certainly do cost less in the long run. Dry batteries are, however, much less troublesome to handle, are more convenient, and may be depended upon with a reasonable degree of certainty if well taken care of. It is always advisable to fit batteries in duplicate sets, either of which may be used

On an engine of any considerable size, batteries should not be depended upon for continuous running, but a magneto should be used except for starting, allowing the batteries to retain their strength. A double throw switch serves to throw in or out either battery or magneto. Batteries are connected in series, the zinc of one cell with the carbon of the next, and so on.

ACCUMULATORS.

Storage batteries may be used, but are as yet little used in marine work. They are especially useful where a miniature lamp or two is desired, to facilitate handling the boat at night, as when coming to a mooring, as the lighting circuit can be taken from the same battery that is used for sparking the engine.

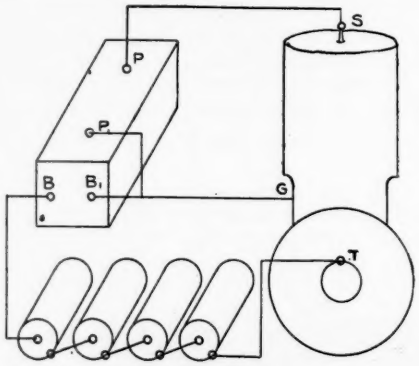



FIG. 46.

MAGNETO.

This is a small dynamo electric machine used to give electric machines wound to give an alternating current; it is run from the flywheel by means of a belt or friction wheel. A magneto should be used for steady running, and should be wired so that it may be switched into the circuit after the engine has been started on the batteries. They are comparatively inexpensive, and their use will effect a considerable saving in battery expense in a boat used very frequently.

WIRING.

Fig. 42 shows the simple wiring for a single cylinder, make and break spark. The batteries *B* are connected in series, as before stated; one terminal from the batteries is wired to one terminal of the spark coil *C*; the other terminal of the coil is connected to the insulated electrodes of the igniting gear. The other battery terminal is fastened to or "grounded" on the metal of the engine. The circuit is thus complete, and may be made and broken by the sparking gear as before described. A switch, *S*, is inserted to open the circuit and prevent waste of batteries.

When duplicate sets of batteries are used the connections are as shown in Fig. 43, a three point switch *s* allowing the use of either set.

When a magneto is used in addition to the batteries, one terminal of the magneto is connected to the ground-wire *G*, and the other terminal to a three point switch, *S*, allowing the use of either magneto or batteries.

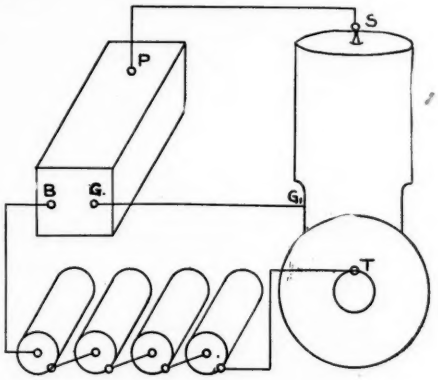



FIG. 46.

The typical connection for a jump spark coil to a single cylinder engine is shown in Fig. 44. The coil is represented at *C* with the binding posts *P P*, *B B*, as before; *T* is the insulated electrode of the timer, and *S* is the spark plug. *G* is the "ground" or connection to the metal of the engine. The batteries are connected in series, as shown; from one battery terminal a wire is run to the timer, and the other terminal is connected to one of the primary posts, *B*. From the other post *B* a wire is led to the ground *G*. It is evident that the primary circuit is complete except as made or broken by the timer.

One of the posts *P* is connected to the spark plug, and the other to the ground, thus making a circuit for the secondary except at the spark gap where it jumps. It will be plain that whenever the connection is made or broken by the timer *T* a spark, or series of sparks, will take place at the plug *S* igniting the charge.

It will be noted that there are two ground wires, one leading from each of the posts *P* and *B*; these two wires may be replaced by a single wire when the connections are as in Fig. 45, which might be taken as the standard wiring for a four terminal coil.

Since the posts *P'* and *B'* are connected, it is becoming the practice to connect them inside of the coil box and thus dispense with the post $P_1$, making a three terminal coil, as shown in Fig. 46, which also shows the connections, which are practically the same as in Fig. 45. In Fig. 47 is shown the additional wiring for two sets of batteries and a dynamo.

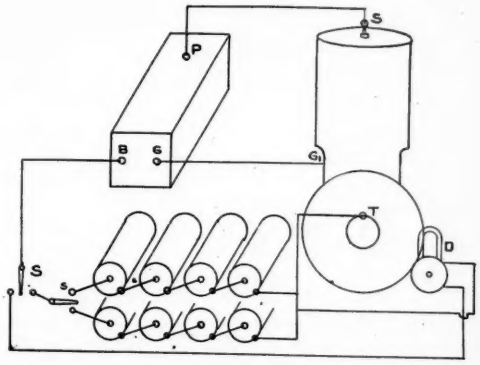



FIG. 47.

In certain cases, also, a single coil may be used for a double cylinder engine. These are principally in cases of the double opposed type, or in the four cycle type with the pistons moving together. The connections then are as in Fig. 48, using a double pointed cam with a single terminal, giving two contacts for

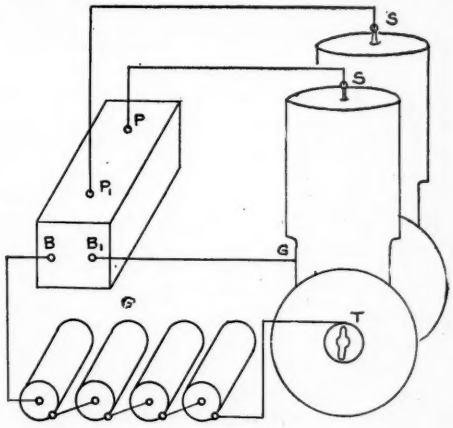



FIG. 48.

each revolution. The usual practice is, however, to use one coil for each cylinder, as in Fig. 49, the general connections being similar to Fig. 46. Three terminal coils are shown, but if four-terminal coils are used one of the secondaries is connected over to one of the

primaries, as shown by the dotted lines, in a manner similar to that of Fig. 45; there are two insulated posts on the timer, one for each cylinder.

It is customary for multi-cylinder engines to combine all the coils into one box for compactness and simplicity. A common form of duplex coil with con-

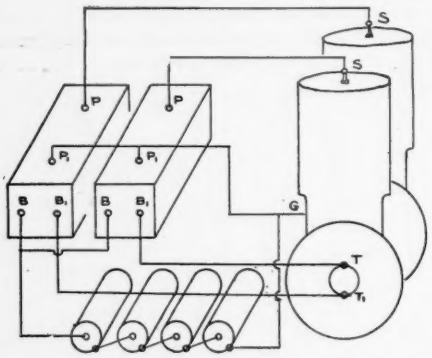



FIG. 49.

nections is shown in Fig. 50, which should be sufficiently plain without further explanation. Another, and perhaps more usual form of duplex coil, is illustrated in Fig. 51, some of the connections being made inside of the box; this sketch again is self explanatory.

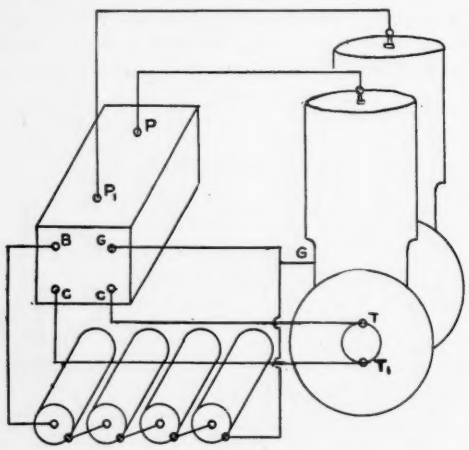



FIG. 50.

These sketches can, of course, show only the connections of the most common forms of coils. Coils are usually accompanied by wiring diagrams showing the connections for different conditions but with the above in mind no difficulty should be experienced. In any of the above diagrams the extra connections for the additional set of batteries or the dynamos may be easily added by following the principle of Fig. 47.

A device for distributing the secondary current is called a "distributor." It requires the use of only one coil as the secondary current is taken from the coil and sent to each cylinder in turn. In appearance and principle it is like the ordinary timer, in fact both timer and secondary distributor are contained in the same case. The principle is illustrated by Fig. 52 where *T* is the primary circuit breaker consisting of a cam having as many projections as there are cylinders; these projections rub past the insulated contact piece *C* and thus make and break the primary

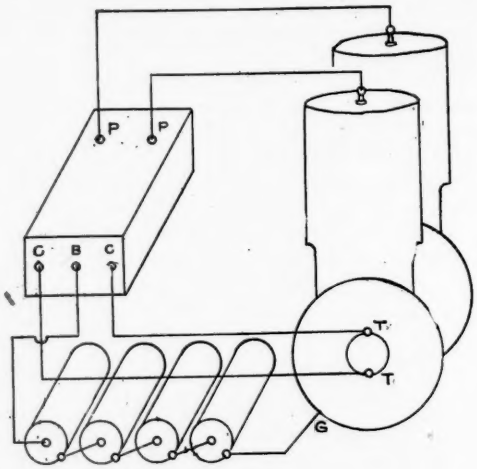



FIG. 51.

circuit. A revolving cam *B* makes contact with the insulated plates *P P P P* corresponding to the number of cylinders. One terminal is wired to the arm *D*, which is insulated from the shaft, the other terminal is grounded on the engine; wires are run from the posts *P*, to the spark plugs. It is thus plain that whenever the timer *T* makes and breaks the contact with *C* the arm *D* will be in the proper position to deliver the secondary current to the proper plug.

The question as to the use of one or the other systems must be a question of the individual conditions; the make and break system is very simple from the electrical standpoint, as the wiring is simple and only low tension current is dealt with. The igniting gear, on the other hand, is apt to be rather complicated, with many small parts which wear and become noisy. This system is well suited to working boats, which are likely to receive little care, and to others where the whole outfit is liable to be exposed to the weather. For extreme high speed the igniting gear is apt to be somewhat erratic, as the springs do not act quickly enough to operate between strokes and it is certainly very noisy at high speed even when in good condition. The cleaning of the sparking points is also likely to be a considerable nuisance, as they are seldom so arranged as to be easily gotten at.

The jump spark system makes possible a very simple engine, as the only parts required for the ignition are the timer and plug. The engine is free from all ignition gear requiring oiling and care, trouble in the system is usually easily located and remedied; trouble at the sparking points is easily overcome by replacing the plug with another and cleaning up the first at leisure; the timer, also, is easily gotten at and simple.

On the other hand, the wiring is rather more complicated and must be most carefully done; the current in the secondary wires is, as before stated, of a very high voltage, and special insulation must be used to prevent leakage. The secondary wiring and coil

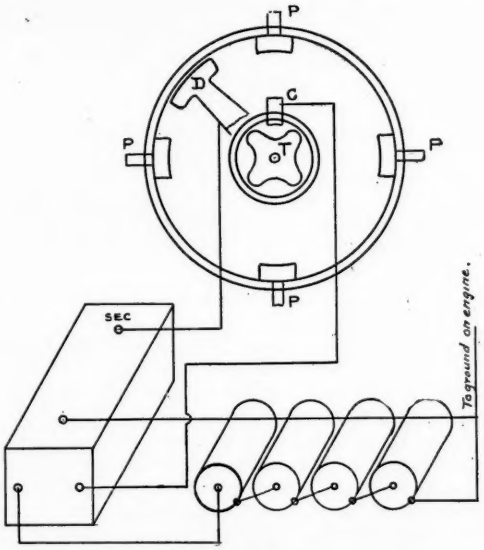



FIG. 52.

must be protected from rain or spray, as moisture is sure to cause a short circuit. It is also quite uncomfortable if the current becomes short circuited through any part of the person. With care, however, these points may easily be guarded against and the jump spark system becomes very simple and satisfactory. The outfit of coils and timer is, of course, more expensive than the outfit for the make and break system, but these parts are durable and permanent, and the cost of the complicated igniting gear is saved so that when the complete outfit of engine and accessories is purchased the slight additional cost is not felt. For cabin boats where the machinery is protected from moisture the jump spark is particularly well suited, and there is no reason why it may not be used if desired in almost any circumstances. The secondary coil must, of course, be protected from spray and rain, but this can easily be done by stowing the coil in a convenient locker or box, and in the case of a shower a piece of canvas may be thrown over engine and wiring.

Distributers are as yet little used and are fitted for engines of four or more cylinders where the wiring would be more complicated; for small engines their use would not be advised at present.

## SOLDERING PASTE.

Soldering paste has come into extensive use in electrical work as a flux for soldering, says the "Brass World." This has been brought about by the requirements of the electrical trade that in certain forms of soldering no acid shall be used. For soldering copper wires for electrical conductors, soldering paste is almost exclusively used. It has also entered other fields of soldering, particularly in instances where spattering and corrosion are objectionable.

Soldering paste which is now used in the electrical trades consists of a mixture of a grease and chloride of zinc. The grease which is commonly used is a petroleum residue such as vasaline or petrolatum. Such a material is about right in consistency. The proportions which are used are as follows:

| | |
|---|---|
| Petrolatum | 1 lb. |
| Saturate Solution Chloride of Zinc | 1 fluid oz. |

The use of petrolatum instead of vasaline is recommended. While they are identical in composition, the name "vasaline" is registered as a trade-mark and commands a higher price on this account. Petrolatum is much cheaper.

The chloride of zinc solution is made by dissolving as much zinc in strong muriatic acid as it will take up. An excess of zinc should be present and all the acid neutralized. This will form a thick, oily solution. The petrolatum and chloride of zinc are mixed and thoroughly incorporated by means of a mortar and pestle, or by vigorous stirring. The advantage of this soldering paste lies in the fact that it does not spatter and is not corrosive.

---

The chemical composition and character of crude petroleum oils vary greatly in the different localities where the oils are found. They are all complex hydrocarbon compounds. The more carbon they contain the greater their specific gravity and the higher the temperature required to evaporate them. The petroleums of Russia belong generally to what is known as the naphthene series. Those of Pennsylvania, Ohio, Colorado and Wyoming have a paraffine base, and those of California and Texas have an asphalt base.

---

The only commercially successful method of producing aluminum is by electrolysis, and all attempts at making aluminum in the electric furnace by reduction of aluminum with carbon have been unsuccessful. Although it is possible to prepare alloys of aluminum by reduction of the oxide by carbon in presence of such metals as copper and iron, yet when it is attempted to obtain the pure metal by direct reduction, the product is almost exclusively aluminum carbide.

# ELECTRICAL EQUIPMENT OF A WAYSIDE INN.

W. A. WAKEMAN.

While on a short trip into the country some time ago, I stopped at a wayside inn, and seeing evidence of an electric equipment, I found the engineer and expressed a desire to see his plant. He proceeded to show it and explain its details in a way that made it appear as a pleasure to him, and certainly was a source of satisfaction to myself. Although the plant is not large it is one of the most complete that I have ever seen, and on account of the precautions taken to prevent interruption of the service, it is well worth a complete description in order that others may profit by the foresight herewith displayed.

Fig. 1 is a plan of the plant and is explained as follows:

A horizontal tubular boiler of about 50 horse power is shown at 2, furnishing steam for an old-fashioned automatic cut-off steam engine, 3 having a cylinder about 10 x 30 inches. The fly-wheel of this engine is belted to the main pulley 4, which is on a shaft overhead in the room, and it was located high enough to be well out of the way.

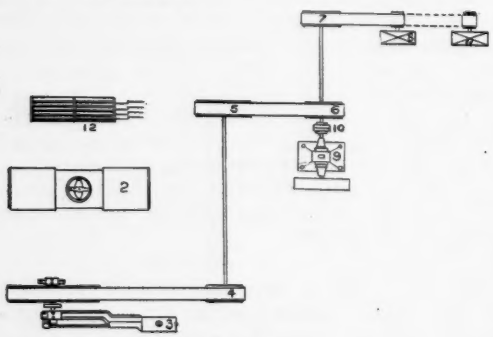



FIG. 1.

On the other end of this shaft there is a larger pulley 5 on which is a belt that drives a smaller pulley, 6, thus increasing the speed of the second shaft, which is only about 7 feet above the floor, and is supported on floor stands in the usual way. This shaft carries another pulley 7, which is belted to a dynamo 8, which supplies current at 110 volts to lamps in all parts of the main building, also in several smaller structures and for a beautiful lawn.

The above description covers the plant as run under normal conditions. As the engine runs at a slow speed with three belts between it and the dynamo, it cannot be considered up-to-date and it is not illustrated for this purpose, but it supplies light that is satisfactory for this particular place, and the whole plant was installed at a very low cost.

A vertical high speed engine is shown at 9 and on the outer end of its crank shaft there is one-half of a coupling, 10, and the other half is on the countershaft. There are no bolts in this coupling, therefore the shaft is free to revolve while the engine remains at rest under normal conditions, but if the larger engine should be disabled from any cause, the belt on 6 would be thrown off, bolts put in 10, and the engine, 9, started without delay, thus continuing the service.

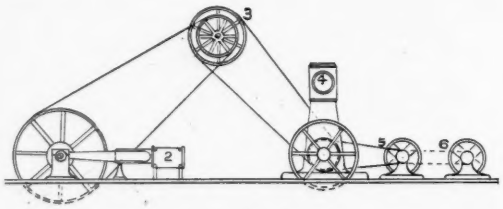



FIG. 2.

This inn was a well and favorably known resort long before trolley lines came into existence, but now a 550-volt system is in operation, a few rods from the house, and from this, a reserve or "break down" service is secured as follows: In case both engines, 3 and 9 are disabled, or if the boiler 2 should be thrown out of commission so that steam could not be supplied to either engine, the belt on 8 would be thrown off. A 550-volt motor is shown at 11, taking current from the street service, as above mentioned. The belt in dotted lines would be put on, thus making it possible to drive the dynamo 8 by the motor 11.

Current is not taken direct from the street service and used for lighting purposes on account of the difference in voltage, as the former is 550 while the latter is 110. Of course it could be done by wiring five 110 volt lamps in series; but that is not best practice, because if one of these lamps should burn out it would disable four more. Another reason for this arrangement is that it is always desirable to keep the voltage as low as possible, and as the distance over which current is carried in this case is short, there is no need of a high tension.

Although we usually think of a rotary transformer as a compact machine without belts, as both motor and dynamo are on one shaft, still a consideration of this outfit shows that the dynamo 8 taken in connection with the motor 11 with a belt connecting them, constitutes a rotary transformer for a direct current, reducing it from 550 to 110 volts.

A storage battery is shown at 12 that is charged dur-

ing the day for use in an emergency at night, therefore if both engines 3 and 9 were disabled and the trolley service cut off from 11, the lights could still be supplied for one evening from this storage battery.

Fig. 2 still further illustrates this plant, as it is an elevation of it, in which 2 is the slow speed engine belted to the main shaft 3 from which a belt is carried down to shaft near the floor that can be coupled to the vertical high speed engine 4 whenever it is wanted to drive the dynamo 5. The motor is shown at 6 with the belt to be used in emergencies in dotted lines.

As the trolley line above mentioned is several miles long, there is more or less danger of lightning striking it and following the wires into this plant, especially as a portion of the trolley line extends over a mountain. To prevent accidents from this source a lightning arrester was installed at the inn. A few days previous to the time that I saw it lightning did come in over the line, and it did not leave enough of that arrester to make decent scrap. Instead of providing a more efficient arrester they simply connected the two ends of the line together and concluded it was just as well to get along without anything of the kind.

This appears to be a wrong idea, as it is about the same as running a boiler without a safety valve. It will do no harm so long as only a low pressure is carried, but nobody knows how soon a high pressure will be generated, proving disastrous. We are told that lightning does not strike twice in the same place, but this is not strictly true, and if it was it would not prove a safeguard to this place, because the line might be struck several miles distant and current at a very high tension carried into the inn and cause a disastrous fire.

An elevated tank is provided at this place from which a supply of water under pressure is available. A low service direct acting steam pump is provided for filling this tank. In addition to this, the regular boiler feed pump is piped so that by opening and closing certain valves, it can discharge into the tank in case the low service pump fails.

If both of these pumps are disabled or there is no steam by which to operate them, a hot air pumping engine is installed so that it can be used for this service, and this, of course, is entirely independent of all other sources of power. A wind mill is used for filling this tank when a brisk breeze is blowing.

The buildings comprising this establishment are heated by steam and the water of condensation flows into a receiver from which it is taken by a pump in the usual way, and pumped into the boiler. As there is always at least a slight loss of water in such cases, arrangements are made whereby fresh water can be turned directly into this receiver, thus making this pump a complete boiler feeder independently of the regular cold water pump.

When the receiver pump is out of order, hot water from the drip pipe is allowed to run to waste temporarily, while fresh water is pumped in by the regular boiler feeder, thus providing two ways of feeding the boiler.

The foregoing description is not intended to convey the idea that the machinery in this plant is more liable to be disabled than that installed in other places, but it is expected to illustrate the good judgment shown in designing the plant to prevent accidents that will interfere with the continuous service expected, and in this respect it is far superior to some more pretentious plants that are found in cities, where everything is supposed to be almost or quite perfect. —"National Engineering."

## SILVER SOLDER.

For a brazing solder, no other alloy can approach silver solder. It has the advantage of a low melting point, together with toughness, qualities not possessed by the brazing brasses composed of copper and zinc. Such brasses must be high in spelter in order to obtain the necessarily low melting point and they are, therefore, hard and brittle. They do not "flush" as well as silver solder nor give as clean a joint. The melting point of silver is lower than that of copper and as it does not oxidize when heated it is admirably adapted for use in brazing solders. Its cost is the only thing in its disfavor.

The old, time-honored silver solder mixture which is the one so extensively used, consists of:

| | |
|---|---|
| Fine Silver | 2 parts |
| Pin-Brass | 1 part |

Pin-brass is supposed to consist of 2 parts copper and 1 part of zinc. As it is difficult to obtain brass scrap that is free from lead, the use of copper and spelter is recommended. The mixeure consists of:

| | |
|---|---|
| Fine Silver | 6 oz. or 66.66 per cent. |
| Copper | 2 oz. or 22.22 " " |
| Zinc | 1 oz. or 11.12 " " |

This mixture is called "common silver solder." It answers for the majority of purposes.

A cheap silver is now sold on the market which gives good results in many operations. It contains less silver than the previous formula. The mixture is as follows:

| | |
|---|---|
| Fine Silver | 3 oz. or 50.00 per cent |
| Copper | 2 oz. or 33.33 " " |
| Zinc | 1 oz. or 16.67 " " |

The first mixture has a whiter color than the second. The color of the first mixture is slightly yellow and particularly so when tarnished. Both mixtures roll sheet well or draw into wire.—"The Brass World."

It is said that one of the best and healthiest trades in the world is that of dye-making from coal tar. Tar and the smell of it is the best of all tonics and tissue-builders. The average life of a tar worker is eighty-six years. The mortality is 30 per cent lower than in any other factory trade.

# MAGNESIUM AND ITS USES.

Two properties render magnesium a valuable metal: First, its lightness. It has even a less specific gravity than aluminum. Second, its affinity for oxygen. This fact renders it of great value in deoxidizing other metals.

Magnesium is made in the same manner as aluminum by means ot the electric furnace. Chloride of magnesium is produced. The discovery of magnesium is due to Sir Humphey Davy, but Bussy, in 1830, first obtained it in the coherent condition. The price was then very high and it is only recently that the price has been reduced so that it can be economically used in the arts. Only a few years ago the price was over $5.00 per pound.

Magnesium belongs to the zinc family of metals. Zinc, cadmium, magnesium, and beryllium constitute this group, as they are quite similar in their properties. For example, magnesium burns in the air like zinc, and with the formation of the oxide.

In color magnesium is much whiter than aluminum and has more of a silvery lustre. The specific gravity of aluminum is 2.56 and magnesium is 1.75. It will be seen, therefore, that magnesium is much lighter than aluminum. This very fact renders magnesium of much value in the manufacture of aluminum and magnesium alloys. Such alloys are lighter than aluminum, and are strong and stiff. There is no other metal that can be added to aluminum to harden it except magnesinm which will not increase its specific gravity.

For light alloys, magnesium opens up an entirely new field, and as alloys, lighter than aluminum and equalling brass in strength, can be made from a mixture of aluminum and magnesium, many new uses will be found for them.

The fact that magnesium has more affinity for oxygen than any other metal renders it the strongest deoxident. It is the only deoxidizing agent that will decompose carbon monoxide when it is present in a melted metal. It entirely elimiuates all gases from a molten metal, therefore, and sound castings result. In this direction it will accomplish results impossible with other deoxidizing agents.

Magnesium has such an enormous affinity for oxygen that when in a finely divided condition, it will burn with the formation of an intense light. This property has brought about its use in flash light powders used in photography.

A popular belief exists that, inasmuch as magnesium in the form of powder will burn, that large masses will likewise burn easily. This is not so and a large mass of magnesium, such as the commercial sticks cannot be made to burn any more than zinc under similar condition. It is only the finely divided material that is combustible. In a flash light powder it is not the magnesium itself that is explosive, but the mixture of the magnesium powder and chlorate of potash. Magnesium itself, either in powder or masses, is not dangerous to use.

Heretofore, many failures in the use of magnesium occurred on account of the impurity of the commercial magnesium that was on the market. Much of the magnesium contained sodium, silicon, and other impurities, which interfered with some of its uses. It is possible at the present time, however, to obtain magnesium of great purity and in an easy form to use. It is now sold in the shape of sticks about half an inch square and a foot long. These sticks have been sawed out of a solid block and are very covenient to use.

The difficulty which has been experienced heretofore in using magnesium as a deoxidant has been in the use of too great a quantity. Only enough should be added to reduce the oxide and gases that are present. The addition of several per cent. of magnesium as frequently recommended, is not conducive to good results. The large excess of magnesium in copper, for example, renders the casting dirty. The quantity of magnesium to be added is usually about 2 oz. of magnesium to 100 pounds of metal. Frequently less will do the work and give better castings. — "The Brass World."

---

The first vessel to navigate the great lakes was the "Griffon," built by La Salle and his party in 1679, near the site of the present city of Buffalo, on Lake Erie. The "Griffon" was about 50 tons burden, and and carried La Salle with 34 men and five guns safely from the point where she was built to Mackinac, and thence to Green Bay. She started to return with a cargo of furs in the following year, but was lost, probably on Lake Huron. From the 50-ton "Griffon" to the 7500-ton iron ore carrier of today is a long step.

---

Engraved diamonds show some very beautiful effects. It is reported that a French jeweller, Bordinet, has invented tools for diamond engraving, and it is said that only his son is permitted to use them. Among the surprising things produced is a diamond cut in the form of a ring, polished on the inside, and covered with delicate engraving on the upper surface. Another is an engraved diamond fish. Diamonds are also engraved with armorial bearings.

---

Quartz crystals, unless large and without flaws, are of but little value as cabinet specimens. Fine, large, clear crystals or twin crystals are valued, particularly the latter. Twin crystals of quartz, when perfect, bring high figures, $100 or more having been known to be paid for superb quartz crystals from Japan.

# A SEWING STAND.

W. E. SHEPLEIGH.

The sewing stand here described is one that was redesigned from a Japanese table, simplified to permit of more easy construction. The original from which it was taken was an extremely useful piece of furniture, but which from long usage reached that dilapidated condition which forbade further repairs, hence a successor was needed, the design of which is shown in the drawing.

The wood used for its construction was mahogany or, more correctly, Mexican baywood, which is so commonly passed off to the novice as mahogany. In this case, however, the less valuable wood is the best to use, owing to the straight grain and easier cutting.

The drawing shows pretty clearly the design and construction, and the work is of such simple character, so that anyone having a fair degree of skill with woodworking tools may turn out a very presentable piece of work.

The legs are 29 in. long and 1¼ in. square. The top is 16 in. long, 14 in. wide and ⅞ in. thick. It would be advisable to fit cleats 2 in. wide and ⅝ in. thick to the ends, to prevent warping, although these are not shown. If the top is glued up from three or four narrow pieces, the cleats will not be necessary.

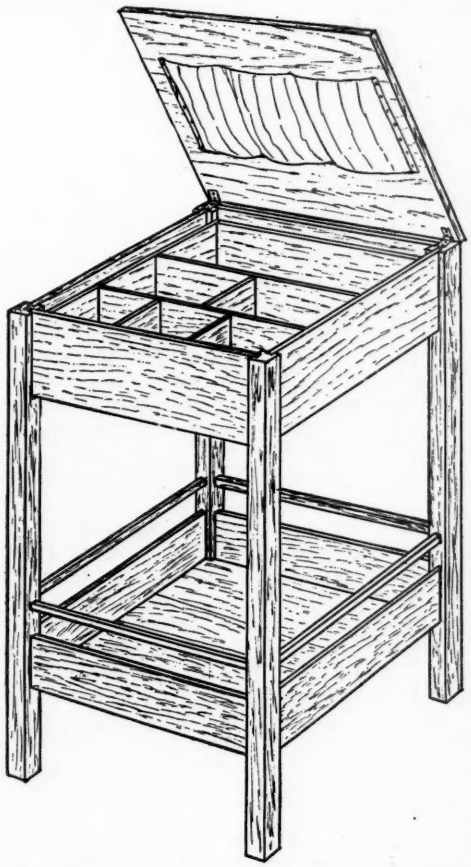
The ends of the top tray are 12 in. long, which allows ¼ in. on each end for tenons; they are 6 in. wide and ¼ in. thick. The sides are 14 in. long. These lengths are also those for the lower tray, the pieces for which are 4 in. wide and for the rods above it, which are ⅝ in. wide, and are 1 in. above the upper edges of the pieces below, which are 6 in. above the floor.

These dimensions will permit laying out the stock and cutting all the mortises in the posts, which should be very carefully done.

The bottoms for both upper and lower trays are 13¼ x 11¼ in. and ¼ in. thick. The corners are cut out to fit around the posts, and they are nailed in place with 1¼ in. wire nails of small wire and heads, after all parts have been fitted and assembled.

The movable tray in the upper part can be replaced with simply the partitions, or it may be made as a separate fixture, as shown. In this case the sides are 12¼ and 9¾ in. long, 4½ in. wide and ⅝ in. thick, provided cloth pockets are desired on the top, or may be 5¼ in. wide, if without the pockets. The partitions are made of pieces ¼ in. thick, the center cross one having finger holes cut about 1 in. from the top for lifting in and out. The arrangement of the divisions shown is a good one, but can be varied to suit the fancy of the builder. The bottom of the movable tray is 11¾ x 9¾ x ¼ in., the width of the partitions being ¼ in. less than as given for the sides.

The cloth pockets are made of cretonne or similar material, tacked to the top with upholstering tacks at the ends and bottom. The upper edge is fitted with elastic, tacked at the ends and at the divisions, which



are also made with tacks. The hinges are fitted to the ends of the posts, with the pins flush with the rear edge, which permits the top to be lifted to a vertical position without going further backward.

---

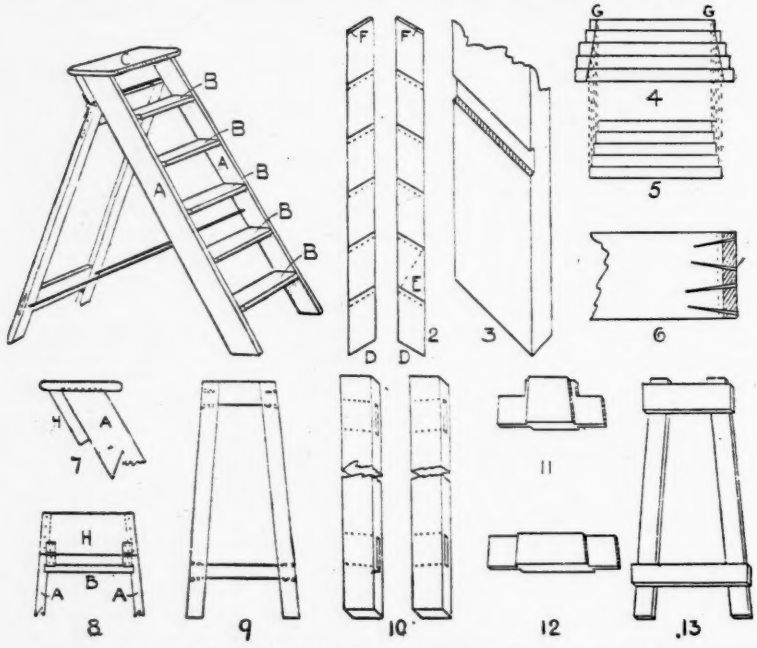
A factor of safety for a laced belt is one-sixth its breaking weight for leather, and one-eighth for rubber. A belt traveling 3500 feet per minute will require a tension of but 9.5 pounds for each inch in width, in order to transmit one horse-power, and one having a width of 100, divided by 9.5, equalling 40.5 inches, will transmit 100 h. p.

# A PAIR OF STEPS.

The steps shown complete in Fig. 3 are most useful and at the same time most durable, notwitstanding the various other kinds which have been introduced of late years, the sole merit of which, as a rule consists in novelty.

The full height of those shown is four feet six inches, which is sufficient for all requirements in the average house, but if anyone wishes for higher steps, the sizes of the timber given hereafter will be ample for anything up to ten steps, or seven and a half feet high.

The principal portion of the steps consists of the two sides *A*, the steps *B*, and the top *C*. The sides should




be about four inches wide by an inch thick, the steps the same thickness, by about five inches wide, and the top about eight inches wide.

The setting out of the sides is the most important part, it being necessary to make the trenches in which the treads fit at such an angle that they will be level when the steps are open. The angle shown is a very suitable one, and it can be taken from the drawing.

To set out, lay the two sides flat on the bench, as in Fig. 2, and first striking the bottom level at *D*. Measure up from this, and strike the next one, and so on, till the top is reached. These lines represent the treads (or steps), and the thickness of these must be taken downwards, as per dotted lines, the trench being formed by cutting away the wood between.

In measuring from step to step the rule must be held at right angles to the lines, as dotted line *E*, the distance from top to top being nine inches. At the extreme top the thickness of the top board *C* must be taken off the length, which gives the line *F*, and to this must be added the quarter of an inch as shown, being to fit into trenches made in the top to receive them. The sides must be trenched to a uniform depth of a quarter of an inch, as in Fig. 3, taking particular care not to cut deeper, or the sides will be weakened.

We now come to the steps (treads) which, owing to the top of the steps being narrower than the bottom, have all to be of different lengths. A suitable width is fifteen inches at the bottom. and twelve inches at the top. To ascertain the length of the various treads required, lay them all on edge, as in Fig. 4, and set off the above dimensions on the top and bottom, connecting these points by two bevelled lines, as *G*. Then square off each tread from these lines, the result being as Fig. 5.

In theory the end of each tread should be cut off slightly, but the angle required is so near a right angle that it is not worth troubling about, the nailing in of the treads making them fit in a satisfactory manner.

It is often recommended that one or more of the treads be tenoned through the sides, but this is not necessary. Nailing will hold them quite firmly, pro-

vided that the nails are driven in at various angles, as in Fig. 6, which causes the nails to hold one against the other, so that to get the sides off the nails must be bent, requiring great force.

The sides being nailed to the treads, the top must next be put on, the position of the trenches in same being found by placing it on the sides and marking round them.

The back piece *H* is nailed to both sides and top, and should be about six inches wide, finishing off level with the sides as shown in Figs. 7 and 8.

The back legs of the steps should be made as Fig. 9, the full width is given by the steps themselves, while the length should be about six inches less than the distance from the back piece to the bottom of the sides. Suitable dimensions for the back legs are three inches wide by an inch thick for sides and bottom rail, the top rail being an inch wide.

Fig. 10 shows the two sides mortised ready for putting together, the slope of the mortises being shown by dotted lines, while the top and bottom rails are shown in Figs. 11 and 12 respectively, with tenons cut.

Fig. 13 shows the method of setting out the mortises in the sides and the tenons on the rails. The former are laid flat at the required distance between, at both top and bottom, and the latter are laid on them in their correct position, when it is easy to mark both the mortises and the shoulder lines with a certainty of getting a good fit when cut.

The back legs should be hinged to the back piece with a pair of strong flap hinges, these being shown fixed in Fig 8.

The two cords which prevent the steps opening too wide should be placed as in Fig. 1. They will then hold the back legs firmly, and will not get entangled in the steps when these are closed up. If the cords are fixed there is great strain on the latter, and the steps are never firm, owing to the bending of the sides of the back.

The writer has a pair of steps made as above, which have withstood extremly rough usage for over fifteen years and not a nail has started.

## BOOKS RECEIVED.

THE AMERICAN ANNUAL OF PHOTOGRAPHY AND PHOTOGRAPHIC TIMES ALMANAC FOR 1907. 354 pp. 9 x 6 inches. Copiously illustrated. Cloth, $1.25; paper, 75 cents. George Murphy, Sales Agent, New York.

This photographic annual is now too well known to all interested in camera work, to require other than a simple announcement of its publication. As noted by the editor, it has with this volume attained its majority, this being the twenty-first book of the series. As becomes such an auspicious occasion, the contents by well known contributors are of more than usual excellence, and both the amateur and professional will alike find much of value. The numerous illustrations are finely done; the practical end is taken care of by some seventy pages of formulas, making in all a book well worth the price.

HINTS AND HELPS FOR YOUNG GARDENERS. H. D. Hemmenway. 60 pp. 9 x 6 inches. 18 illustrations. Paper, 35 cents. Published by the author at Northhampton, Mass.

This book was written with a view to furnishing a low-priced guide to school and home gardeners. Not only is it suitable for youthful gardeners, but also for those young in experience. It contains just the information required by one desiring to cultivate a small flower or vegetable garden, tells where and how to plant, both indoors and out, as well as the care of plants after planting. It is brim full of directions, clearly expressed.

PRACTICAL LETTERING. Thomas F. Meinhardt. 15 pp. 14 x 9 inches. Illustrated. Paper, 60 cents. The W. W. Henley Publishing Co., New York.

The author gives special prominence to a mechanical scale for laying out letters and the spacing between them, which enables letters of any size and style to be correctly drawn. The principle having been acquired, this being facilitated by several alphabets of different styles, which are sectioned according to the scale, the worker is able to dispense with much of the scale work and yet accurately draw and space the letters. It is more particularly adapted to sign painters than for draftsmen, and should be very useful to anyone desiring such instruction.

COMPLETE EXAMINATION QUESTIONS AND ANSWERS FOR MARINE AND STATIONARY ENGINEERS. Calvin F. Swingle, M. E. 367 pp,. 7 x 4¼ in. 212 illustrations. Flexible leather, $1.50. Frederick J. Drake & Co., Chicago, Ill.

The author imparts his information in the catechetital form through some 800 questions and answers. As the questions are short, although carefully worded, and the answers quite full, the result is an exceedingly instructive book, especially adapted for study without an instructor, and during odd moments of leisure time. In addition to the recipocating type of engine, the turbine receives appropriate mention.

---

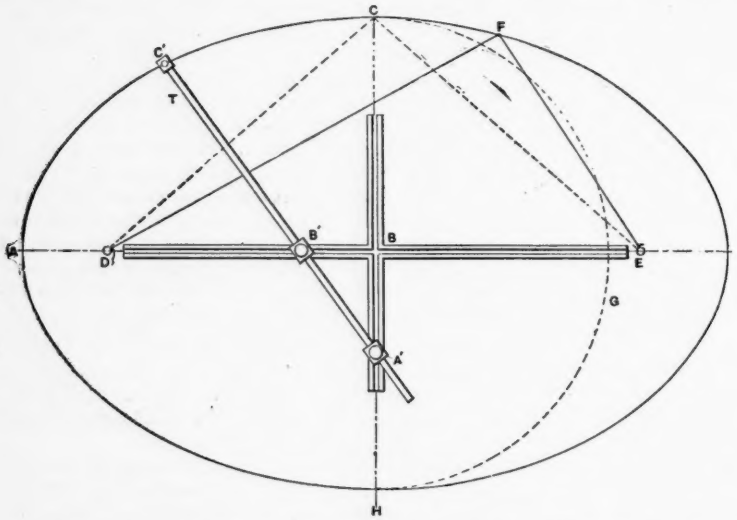
Paraffin softens and becomes very pliable at many degrees below its melting point. It burns with a pure and brilliant white flame when supplied with sufficient air for complete combustion. Candles made entirely of paraffine are not suitable; but by mixing stearic acid or vegetable wax, etc., this defect may be overcome.

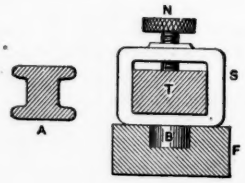
---

One gallon of water weighs 8.33 pounds and contain 231 cubic inches. One cubic foot of water weighs 68.5 pounds and contains 1728 cubic inches or 7.5 gallons. A miner's inch is a flow of water equal to 1.5 cubic feet per minute, or 11.25 gallons per minute.

# INSTRUMENT FOR DRAWING AN ELLIPSE.

It may be interesting for some of the readers to know how to draw an ellipse of any size, as well as an egg shaped figure or oval, Fig. 1, similar to the cross section of a sewer, writes W. McD., in "Carpentry and Building." The instrument for doing this consists of two parts, one of which is cross shaped, the pieces being at right angles to each other and having a groove in their top surfaces. The other part of the instrument consists of a beam with two sliding buttons having round pins on the under side to fit into the grooves of the cross piece, also a pencil fixed into a button at the end.




I might mention that I saw this apparatus about 25 years ago in a large horticultural concern where I was designer. The trammel is exactly the same as the beam of a beam compass, with this difference, that it has a circular button to fit into the groove instead of a needle. Again, the beam or trammel of the beam compass is usually I-shaped, as shown at *A* in Fig. 2, but this is flat, as the sleeve *S*, which holds the knob or button, keeps it sufficiently rigid, as indicated in the larger section. The salient feature of the apparatus is not so much the trammel as the grooved cross shaped frame in which it works. The principle could be applied to the generation of a large ellipse by simply having two lines laid off at right angles representing the major and minor axes of the ellipse, and then taking a batten and putting in nails at the length of the half major and half minor axes. Then when the nail representing the minor axis is placed anywhere on the major axis, and the nail representing the major axis is swung around until it rests on the minor axis, then the end of the batten is the point of the ellipse

In order to generate an ellipse make C′ B′ of the diagram equal to C B, which is half the minor axis of the ellipse, and make A′ B′ equal to A B, which is half the major axis of the ellipse. Now place the buttons in the slots or grooves and slide them along so that when B′ moves along the horizontal slot A′ will simultaneously move along the vertical slot, then C will generate an ellipse.

To generate an ellipse by means of a cord we first draw the major and minor axes and then take half the major axis A B and with C as a center draw an arc bi secting the major axis in D and E. By this means D and E are established as the focii of the ellipse. Place pins at D and E with a cord around them and then stretch it until it comes to C; now with the cord kept taut, generate the ellipse. While this is an easy method of doing the work, the one first described is more exact. For generating a still larger ellipse a wire can be used instead of a cord, as the latter stretches and the whole value of the operation consists in its exactness.

---

A temperature of −60 to −80° F. is not dangerous to human beings who are properly clothed, if the air is still, while 30 or 40° higher, if accompanied by a gale of wind would kill every living thing before it. Very low temperatures almost invariably coincide with perfect atmospheric quiet.

---

Tubing of copper, one inch inside diameter of standard thickness, will stand a heat of 700° F.

## CORRESPONDENCE.

No. 159. MOOSE LAKE, MINN., Oct. 26, 1906.

Can a Ruhmkoff induction coil be used with a jump-spark gasoline engine with good results, and what should be the rated spark far a small 3-h. p. engine.

C. A. J.

This inquiry is quite fully answered elsewhere in this issue, in the chapter on "Gasoline Engines." The ordinary coil sold for sparking purposes for jump spark ignition should give a fat spark of from ⅜ to ½ in. long when operated with four new dry cells of battery.

No. 160. ASHEBORO, N. C., Oct. 9, 1906.

Is gasoline vapor lighter or heavier than air? Where should the igniter be placed on a vertical gasoline engine. Does the charge of air and gas have to be taken into the cylinder of an engine before it will gnite.

W. C. A.

Gasoline vapor is heavier thon air. Because of this fact the ventilation of boats and shops having engines using this fuel must be carefully attended to. A leaky feed pipe in a boat or building will allow an explosive vapor to accumulate in any enclosed place, and when the odor of such vapor is noticed, no flame should be allowed in the neighbrhood until after a strong current of air has circulated long enough to ensure the absence of danger.

Read the chapters recently published on "Gasoline Engines" for information about igniters.

The power of a gas engine is largely dependent upon the compression of the explosive vapor previous to ignition. Without compression, no useful work could be obtained from an ordinary gas or gasoline engine. Toy gas engines are made which, withont compressing the charge, revolve at a high speed, but develop little or no power.

No. 161. BELMONT, MASS, Oct. 23, 1906.

Will you please give the B. & S. gauge numbers for the primary and secondary wire for the 1½ and 3 in. spark coils described in the October, 1905 number.

I have a standard pony relay wound to a resistance 20 ohms. Would it be suitable for wireless work if rewound for a higher resistance?

What size of wire would be required to give a resistance of about 100 or 125 ohms? J. H. P.

For the primary winding of a 1½ in. spark coil, the No. 16 B. W. G. may be replaced with No. 14 B. & S. G., and for the 3 in. coil the No. 14 B. W. G. with No. 12 B. & S. gauge, these numbers being sufficiently approximate to answer. For the secondary winding use No. 36 B. & S. gauge for general eqperimentnl work, and No. 34 gauge for a coil for wireless work, using about one-quarter more wire and making a larger coil in the latter case.

A "standard" relay is a full size instrument; a pony relay is smaller. Fifty feet of No. 36 copper wire gives 20 ohms resistance, which would have to be replaced with 200 ft. of the same gauge to give 100 ohms or 250 ft. to give 120 ohms. This is the quantity for both coils of the relay, each coil having one-half the wire. No. 38 gauge has 1 ohm resistance for each 1¾ ft. It will probably be necessary to nse single silk covered wire to rewind to the higher resistance, owing to the limited space.

No. 162. MARION, ILL., Nov. 13, 1906.

With an air wire, the top above all obstructions, and using a coherer receiver and a 1-inch spark coil, will a wireless outfit work about 6 miles?

Where can I buy the platinum wire sealed in a tube, as described in the June, '06 number, for use in wireless telegraphy?

Will a 2-inch spark coil operate an X-ray tube successfully? O. L.

The statement has been repeatedly made in this column that no reliable estimate can be made of the distance a wireless outfit will operate successfully. The conditions vary so greatly that actual tests are necessary to determine the capacity and power of such instruments. It is extremely doubtful if the sizes of the instruments you give, have sufficient capacity for even half the distance you state.

You will leave to make up the receiver described in the June, '06, number.

A coil giving a fat 4-inch spark in about the smallest that can used for X-ray work and even with a coil of that size the tube must be a small one. A 6 or 8-inch spark coil is ordinarily used. A 4-inch coil in series with a Tesla coil, will give much better results than the 4-inch coil alone.

No. 163. MOSGROVE, PA., Nov. 20, 1906

Will you please advise me if there is any danger of lightning coming in over an "aerial" wire of a wireless telegraph outfit and damaging the instruments.

L. O. H.

Every aerial wire should be fitted with a lightning arrester and ground as described in the Nov. '05 number of this magazine. If not so protected the instruments, even if any trace of them could be found after a "burn out" by lightning, would be of no value.

No. 164. CARMINE, TEX. Nov. 16, 1906.

How many feet and what gauge wire is used in winding a 20-ohm telegraph sounder?

How many dry batteries should be used to operate a 1-inch spark coil? R. A.

See answer to No. in this 161 column. Five or six dry cells should be sufficient to run a 1-inch spark coil of ordinary construction. With a suitable primary winding as many as eight cells may be used.

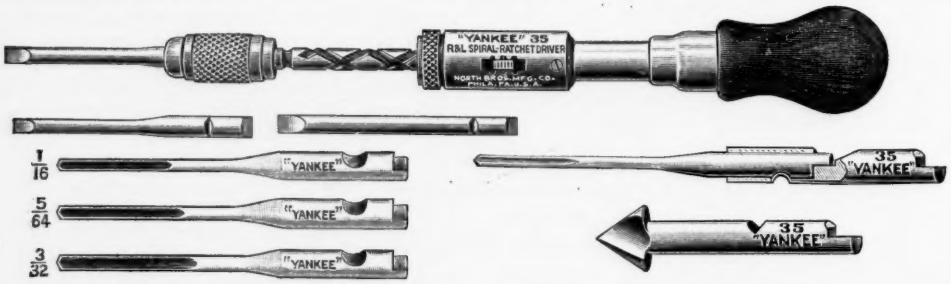
---

Blanks for nickels for coinage cost 14 cents a hundred, and blanks for cents cost 7 3-10 cents a hundred. They are sent to the mint in Philadelphia, where all minor coins are made, and each one is struck with the design that gives to it commercial standing.

## TRADE NOTES.

The spiral-ratchet screw driver here illustrated is intended for electrical workers, cabinet makers, carpenters, boat builders and mechanics having a large number of small screws to drive, and where a light weight tool will be more sensitive and convenient than the standard pattern.

It is small enough to be conveniently carried in the pocket, measuring 7 inches long when closed and without bit, and weighs complete less than 7 ounces. It drives screws in or out and holds rigid when closed or extended. The bits are straight, so they can be used to drive screws through holes in insulators, etc., where the flattened pattern of blades, etc., will not pass through holes. It has attachments of chuck for holding drill points and countersink.




That it is an admirable tool is shown by the enormous sale in the short time it has been upon the market, 500 dozen being sold in the first ten days. It is manufactured by North Bros. M'fg. Co., Philadelphia, Pa., who make the popular "Yankee" tools of a similar character.

The attention of readers is called to the advertisements of White, Van Glahn & Co., 5 Chatham Square, New York City, well known hardware dealers, who make a specialty of mail order trade. Located, as they are, in the center of the hardware district of that city, they possess exceptional facilities for filling orders promptly and at lowest market prices. Unlike some mail order houses, they handle goods of the best quality, and anyone purchasing through them may have the fullest confidence that orders will be filled in an entirely satisfactory manner.

The Carpenter foot power motors should receive the attention of mechanics who desire an easy working, powerful drive for small machinery. It possesses a decided advantage over other foot motors in the speed at which it may be run, making it adaptable for many uses not hitherto possible for foot power. Polishers and grinders, small lathes, etc., but indicate a few of the uses to which it may be put. It is substantially made, and sold at a most reasonable price by the Carpenter M'fg. Co., 30 Oliver Street, Boston, Mass.

---

Renew your subscription before you forget it.

## SCIENCE AND INDUSTRY.

The waters of the Dead Sea contain from 20 to 26 per cent of solid matter in 1000 parts. This includes 7 to 10 per cent of common salt, as much more of magnesian salts and 2½ to 3½ per cent of calcium carbonate and sulphate, also some bromides and alumina.

It is a curious fact that up to 1856 there was no limit on the cent as a legal tender. One might offer ten thousand cents in payment of a debt of one hundred dollars. Since then, however, the cent has been legal tender only up to twenty-five cents.

To clean varnished paint work make up a solution by boiling spent tea leaves in water, and apply this hot with a soft piece of flannel, always rubbing one way. Rub dry with a soft cloth or with clean white waste.

In cutting rubber for gaskets, etc., have a dish of water handy and keep wetting the blade of the knife. It makes the work much easier.

Steel corrodes more readily than common bar or sheet iron under similar conditions, probably due to the finely intermingled atoms of carbon present in the steel.

Gold powder or bronze, is made by grinding gold leaf in a mortar with honey, extracting the honey with hot water and drying the powder. It is used in illumination and miniature painting.

An interesting example of the use of electricity in an emergency occurred recently in Philadelphia. At the Mint a well is being bored which has reached a depth of some 540 feet. A few weeks ago one side of the jar rein of the drill, 18 in. long and weighing 19 pounds, broke off and wedged crosswise in the hole at the bottom. The contractor doing the work fished for ten days trying to recover the broken piece without result. The problem was solved by the construction of an improvised electro-magnet consisting of a piece of steel 5 in. in diameter, on one end of which was wound a coil protected by copper sheathing. Long leads were attached and the apparatus was lowered down the boring. According to the "Electrical Review" of New York, the current, 1½ amperes at 220 volts, was then turned on, and the magnet was pulled up, bringing with it the broken tool and all the metal particles that were in the well from the boring.